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SELECTED WATER RESOURCES ABSTRACTS

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MARCH 15, 1981

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SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 14, NUMBERS 5 & 6
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

STUDIES DIRECTED TOWARD COUPLING AN ENERGY BALANCE SNOWMELT MODEL TO A STREAMFLOW RUNOFF MODEL,
California Univ., Santa Barbara. Computer Systems Lab.
J. Dozier, R. Davis, M. Frampton, J. Frew, and B. Marks.
1980 Final Technical Report for University of California Water Resources Center, Davis, California. Grant W-546. 173 p, 35 Fig, 12 Tab, 162 Ref.

Descriptors: *Snowmelt, *Runoff, *Streamflow, Model studies, Snowpacks, Snow cover, Micrometeorological instrumentation, Alpine regions, Snow hydrology, *Energy budget, Mathematical modelling, Remote sensing, Solar radiation, California, Alpine climatology, Watersheds, Stream forecasts, Satellite radiometry, Albedo, Irradiance.

Snowmelt models using the energy balance approach do not rely on statistical relationships and can thus provide reliable data on melt rates even during extremes such as drought or flood. If properly coupled to a streamflow model, an energy balance snowmelt model driven by calibrated satellite data can improve the short-term prediction of spring runoff during extreme snow years. Six papers describe: (1) A clear-sky spectral solar radiation model calculating incident, net, or reflected solar radiation at any point on a snow surface in mountainous terrain if point albedos are known; (2) Measurement of vegetation densities and analysis of the effect of varying canopy densities on irradiance received at the surface contributing to an accurate model of radiation exchange at the snow surface over a large alpine area; (3) Thermal satellite data used to develop an areal simulation of the surface energy budget of an alpine snowcover; (4) Digital terrain information and numerical atmospheric models combined with spaceborne radiance measurements to compute a surface albedo for any given terrain location; (5) A micro-meteorological station in the southern Sierra Nevada contributing to the testing and development of an energy balance snowmelt model by providing undisturbed measurements of energy exchange components, snow mass balance, and snow and soil properties; (6) Measurements of the heat and mass transfer across air-snow and soil-snow interfaces to compute the melt rates and magnitudes from a snowpack. (Mantius-Omniplan)
W81-00755

HIGH WATER LEVELS IN GROUND-WATER DOMINANT LAKES--A CASE STUDY FROM NORTHWESTERN WISCONSIN,
Residuals Management Technology, Inc., Madison, WI.
M. B. Rinaldo-Lee, and M. P. Anderson.
Ground Water, Vol 18, No 4, p 334-339, July-August, 1980. 5 Fig, 1 Tab, 14 Ref. OWRT A-075-WIS(3).

Descriptors: *Wisconsin, *Surface-groundwater relationships, *Water level fluctuations, *Lakes, *Groundwater, Aquifers, Water table, On-site data collections, Computer models, Model studies, Precipitation(Atmospheric), Groundwater movement, Piezometers, Reservoirs, Flow nets, Potentiometric level, Observation wells, Groundwater recharge.

An investigation into the cause of high lake levels during the early 1970s in a groundwater dominant lake in northwestern Wisconsin was conducted from December 1976 to July 1978, in part to address allegations by shoreline property owners that regulation of water levels in a reservoir 2.4 km south of the lake had caused the high lake levels. High lake levels also coincided with above average precipitation. Data collected during the study allowed the definition of the groundwater flow system around the lake and the calculation of the water budget for the lake. Field data indicated that there is no groundwater flow between the reservoir and the lake and that groundwater flowing out of the reservoir is intercepted by a trough in the potentiometric surface. The trough is probably oriented along a permeable fault zone or a buried river valley. A groundwater flow model was used to determine whether increased recharge rates of the magnitude that probably occurred as a result of above average precipitation in the early 1970s would be sufficient to account for the observed rise in lake level or whether regulation of the water level in the reservoir could be expected to affect lake level. (Visocky-ISWS)
W81-00810

2B. Precipitation

PRACTICAL CONSIDERATIONS IN THE APPLICATION OF SURFACE FITTING TECHNIQUES FOR ESTIMATIONS OF AREAL RAINFALL,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
R. E. Schulze.
In: Preprint Volume, Tenth Conference on Severe Local Storms, October 18-21, 1977, Omaha, Nebraska, p 104-109, 1977. 5 Fig, 1 Tab, 16 Ref. American Meteorological Society, Boston, Massachusetts.

Descriptors: *Mathematical studies, *Rainfall, *Distribution patterns, *Estimating, *Water resources, Least squares method, Evaluation, Rain gages, Simulated rainfall, Precipitation(Atmospheric), Sampling, Gaging stations, Geomorphology, Drainage density, Hydrogeology, Runoff, Watersheds(Basins), Topography, Altitude, Planning, Maps, Mountains, Forecasting, South Africa.

Trend surface analysis of point and areal rainfall in the mountainous Drakensburg area, South Africa, was evaluated for accuracy and used to estimate water resources in the region. The technique is essentially an application of the least squares theory and the physiographic factors such as altitude yield and the adequacy of the rainage network in the area must be included in the analysis for meaningful results. These 4-dimensional hypersurfaces give more realistic rainfall patterns than 3-dimensional surfaces. More improvement in the rainfall maps can be made if the longitudinal and latitudinal grid is aligned with major trends. A comparison of rainfall surfaces and residuals of a small catchment at Cathedral Peak with the Drakensberg area indicated rainfall anomalies associated with local topography. The presence or absence of key stations, especially in peripheral and isolated high altitude stations, can significantly alter rainfall estimations. Supression of variables in order to normalize them in respect to other variables does not improve the analysis. High order polynomials should not be used if the gaging network is incomplete, otherwise erroneous results are obtained. Trend surface analysis of physiographic-dependent rainfall data is an extremely useful tool for water resource planning if coupled with an adequate rainage network. (Sidney-IPA)
W81-00773

2C. Snow, Ice, and Frost

PENETRATION OF SOLAR RADIATION IN SNOW-ICE COVERED WATER RESERVOIRS: WINTERKILL,
Missouri Water Resources Research Center, Rolla.
For primary bibliographic entry see Field 2H.
W81-00979

2E. Streamflow and Runoff

RIPARIAN HABITAT AND INSTREAM FLOW STUDIES, LOWER VERDE RIVER: FORT MCDOWELL RESERVATION, ARIZONA,
Fish and Wildlife Service, Albuquerque, NM.
R. M. McNatt, R. J. Hallock, and A. W. Anderson.
Report, June, 1980. 58 p, 16 Fig, 8 Tab, 50 Ref, 1 Append.

Descriptors: *Streamflow, *Fish populations, *Riparian plants, *Cottonwoods, Arizona, Wildlife, Dams, Groundwater resources, Flow control, Aquatic habitats, Rainbow trout, Carp, Channel catfish, Sunfishes, Bass, Brown trout, Suckers, Minnows, Habitat improvement, Verde River.

The Fort McDowell reach of the Verde River in Arizona contains high quality riparian habitat which supports a wide variety of fish and wildlife species, and riparian vegetation. The riparian zone has value for recreation, flood control, groundwater recharge, bank stabilization, erosion control, honey production, livestock grazing, and fuel wood production. Weighted Usable Area (WUA) curves are provided for selected fishes (rainbow trout, carp, channel catfish, bluegill, green sunfish, largemouth bass) that commonly occur in the Fort McDowell Reach. WUA curves are also provided for brown trout, small mouth bass and white sucker (closely related to native suckers). WUA curves for adult rainbow and brown trout show maximum values at stream flows ranging from 200 to 300 cfs; other species, such as channel catfish and native suckers and minnows, would also be enhanced, if flows of this magnitude can be maintained. A high rate of mortality of cottonwood trees coincided with the 1977 drought, when water releases from Bartlet Dam were nearly eliminated. Tree mortality was greatest (60 to 84%) in the stream reach influenced by groundwater withdrawals by the City of Phoenix. It is recommended that a streamflow of at least 200 cfs be maintained along the Fort McDowell reach to maintain and enhance fish and wildlife resources and riparian habitat. (Moore-SRC)
W81-00756

ON THE ELEVEN-YEAR SOLAR CYCLE AND RIVER FLOW,
University of the Witwatersrand, Johannesburg (South Africa).
T. G. J. Dyer.
Water SA (Pretoria), Vol 4, No 4, p 157-160, 1978. 2 Fig, 3 Ref.

Descriptors: *Solar radiation, *River flow, *Dams, *Mathematical studies, *Climatology, *Time series analysis, Correlation anlysis, Africa, Flow, Rivers, Forecasting, Reliability.

Temporal ten-year patterns are shown in a theoretical study covering seven river flows (Zambezi, Okavango, Komati, Pongola, Mooi, Mzimkulu, Steenbras) and in-flows of three dams (Gaberone, Marico-Bosveld, Hartbeespoort), covering the length of South Africa for the intercomparison of flow fluctuations with the solar cycle. No simple relationship was found. In some cases, river flow and solar cycle were in-phase, in other cases they were in anti-phase while in others there were periods of in-phase followed by an abrupt discontinuity leading to anti-phase. It is concluded that an hypothesis of no relationship between river flow and the solar cycle could not be accepted, and further study is recommended. (Zielinski-IPA)
W81-00778

2F. Groundwater

ESSENTIALS OF GROUND-WATER HYDROLOGY PERTINENT TO WATER-RESOURCES PLANNING,
Water Resources Council, Washington, D. C. Hydrology Committee.
Available from Supt. of Documents, GPO, Washington, DC 20402. Bulletin 16 (revised), 1980. 45 p, 6 Fig, 1 Tab, 68 Ref.

Descriptors: *Groundwater resources, *Hydrology, *Planning, Model studies, Water resources, Decision making, Water management(Applied), Aquifers, Surface-groundwater relationships.

With current emphasis on regional and river basin planning for water and related land resources, and increased emphasis on environmental protection and management, it is important that ground water be investigated as a basic element of water supply to determine its availability and utility within local-

ized areas and to consider its broader role in regionwide water resources planning and management. Well-established fundamental principles of groundwater behavior and a fund of descriptive knowledge of the groundwater reservoirs, coupled with recent advances in investigative and analytical methods of groundwater hydrology, provide firm footing for improved planning for management of the resource. Modeling methods constitute powerful tools for prediction of the effects of groundwater withdrawals and for the design of rational programs of management and protection. Incorporating groundwater into water systems management and into broader land and water programs is both feasible and practical. (Moore-SRC)
W81-00759

SURFICIAL GEOLOGY OF RICHLAND QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00813

SURFICIAL GEOLOGY OF PART OF CLEVELAND QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Syracuse Univ., NY.
For primary bibliographic entry see Field 7C.
W81-00814

A COMPARISON OF ANALOG AND DIGITAL MODELING TECHNIQUES FOR SIMULATING THREE-DIMENSIONAL GROUNDWATER FLOW ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
T. E. Reilly, and A. W. Harbaugh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226095, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-14, 1980. 40 p, 16 Fig, 2 Tab, 18 Ref.

Descriptors: *Analog models, *Digital computers, *Model studies, *Numerical analysis, Analytical techniques, Groundwater movement, Hydraulic conductivity, Hydrogeology, Aquifer characteristics, Water storage, Water table, Regional analysis, New York, *Long Island(NY), Finite-difference method.

A three-dimensional electric-analog model of the Long Island, NY, groundwater system constructed by the U.S. Geological Survey in the early 1970's was used as the basis for developing a digital, three-dimensional finite-difference model. The digital model was needed to provide faster modifications and more rapid solutions to water-management questions. Results generated by the two models are depicted as potentiometric-surface maps of the upper glacial and Magothy aquifers. Results compare favorably for all parts of Long Island except the northwestern part, where hydrologic discontinuities are most prevalent and which the two models represent somewhat differently. The mathematical and hydrologic principles used in development of ground-water models, and the procedures for calibration and acceptance, are presented in nontechnical terms. (USGS)
W81-00830

THE EFFECT OF DISSOLUTION OF VOLCANIC GLASS ON THE WATER CHEMISTRY IN A TUFFACEOUS AQUIFER, RAINIER MESA, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W81-00831

GROUND-WATER CONDITIONS AT BEALE AIR FORCE BASE AND VICINITY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-00832

SURFICIAL GEOLOGY OF TEXAS QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Syracuse University, NY.
For primary bibliographic entry see Field 7C.
W81-00837

2H. Lakes

THE CHEMICAL AND BIOLOGICAL EFFECTS OF ANNUAL DIEBACK OF MYRIOPHYLLUM SPICATUM L. AND THE IMPORTANCE RELATIVE TO NUTRIENT CYCLING IN MONROE RESERVOIR, MONROE CO., INDIANA,
Indiana Univ. at Bloomington. Dept. of Biology.
D. H. Landers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-142986, Price codes: A07 in paper copy, A01 in microfiche. Doctor of Philosophy Thesis, 1979. 129 p, 20 Fig, 15 Tab, 70 Ref, 1 Append. OWRT-B-099-IND(2).

Descriptors: *Myriophyllum spicatum, *Nitrogen, *Phosphorus, *Cycling nutrients, *Senescence, Lakes, Standing crops, Environmental effects, Nutrients, Phytoplankton, Chlorophyll, Aerial photography, Evaluation, *Monroe Reservoir(IN).

Enclosures (2-m diameter) were placed in the littoral zone of Monroe Reservoir, Monroe Co., Indiana, to evaluate the chemical and biological effects of late summer dieback of Myriophyllum spicatum. Aerial photography, combined with quadrat sampling, was used to measure the standing crop at peak summer biomass. Plant tissue analysis was applied to total biomass estimates to determine potential N and P release from senescing macrophytes. At the time of dieback, considerable pulses of SRP, HN3-N and N03-N were detected in the enclosures containing plants and in the adjacent open-water sites. These nutrient inputs were associated with episodes of normal macrophyte senescence and decay. Chlorophyll a increased greatly in response to these nutrient inputs, indicating important increases in phytoplankton production as a direct consequence of macrophyte dieback. Crashing autumn phytoplankton populations were responsible for additional pulsed inputs of SRP, NH3-N and N03-N in enclosed and open-water locations. Realized nutrient inputs from senescent M. spicatum are estimated to represent as much as 20% of the annual P. budget, and not more than 2.2% of the annual N. budget for the reservoir.
W81-00752

HIGH WATER LEVELS IN GROUND-WATER DOMINANT LAKES--A CASE STUDY FROM NORTHWESTERN WISCONSIN,
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 2A.
W81-00810

PENETRATION OF SOLAR RADIATION IN SNOW-ICE COVERED WATER RESERVOIRS: WINTERKILL,
Missouri Water Resources Research Center, Rolla.
A. L. Crosbie, and W. Davidson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-149643, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, November 28, 1980. 118 p, 14 Fig, 17 Ref, 2 Append. OWRT-A-113-MO(1), 14-34-0001-9027 & 0127.

Descriptors: *Model studies, *Winterkilling, *Aquatic life, Forecasting, *Iced lakes, *Solar radiation, Ice cover, Reservoirs, Light penetration, Light intensity, Reflectance, Optical properties, Albedo, Snow cover.

A snow-ice covered water reservoir is modeled by two absorbing-scattering planar layers. The scattering centers in the snow layer are assumed to be ice spheres, while the scattering centers in the ice layer are assumed to be spherical voids. The scattering characteristics of each layer are predicted by Mie theory. A Dirac-delta function approximation to the scattering phase function is introduced to simplify the analysis and account for strong forward scattering due to diffraction. An invariant imbedding solution technique is then used to solve the transport equation including multiple scattering for the penetration of solar radiation through the snow-ice layer. Both collimated and diffuse solar radiation are considered. The results show good agreement between the isotropic and anisotropic approximations except at large incident angles and small depths. The penetration of solar radiation is strongly dependent on the asymmetry factor, single scattering albedo and optical thickness of the snow layer. Simplified expressions valid for large optical depths are presented. The reflection of solar radiation is also predicted. The results of this investigation should help predict winterkill (the suffocation of aquatic animal life in the winter months).
W81-00979

2I. Water In Plants

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES, VOLUME VII, MEDITERRANEAN REGION , WESTERN ARID AND SEMI-ARID REGION,
Missouri Univ., Columbia. School of Forestry, Fisheries and Wildlife.
M. A. Walters, R. O. Teskey, and T. M. Hinckley.
Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-78/93, July 1980. 90 p, 19 Fig, 6 Tab, 47 Ref. USDI 92365-0110.

Descriptors: *Riparian plants, *Water level fluctuations, *Arid lands, Semiarid climates, Wetlands, Trees, Shrubs, Floods, Droughts, Seasonal, Arizona, New Mexico, California, Utah, Nevada, southern Idaho, eastern Washington and Oregon. In addition, the effect of drought on woody plants of these regions is described. Riparian vegetation is normally exposed to high groundwater levels as well as to periods of excess water due to flooding. The effect of excess water often causes stress to the plant resulting in decreased growth or even death. A plant's response to flooded conditions depends on many factors, including the species tolerance, water level, duration of flooding and time of year. Available information for individual species of the region is listed in a tabular format. (Moore-SRC)
W81-00765

INPUT AND EARLY DIAGENESIS OF CHLOROPHYLLS IN A TEMPERATE INTERTIDAL SEDIMENT,
Melbourne Univ., Parkville (Australia), Dept. of Organic Chemistry.
F. T. Gillan, and R. B. Johns.
Marine Chemistry, Vol 9, No 4, p 243-253, August, 1980. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Chlorophyll, *Diagenesis, *Intertidal areas, *Sediments, Coasts, Temperate, Australia, Diatoms, Degradation(Decomposition), Stability, Sampling, Algae, Cores.

The initial steps of chlorophyll-a decomposition in temperate sandy intertidal sediment samples from a low-energy coastline of Corner Inlet, SE Victoria were examined. Diatom input into the surface layers was noted as the major source of chlorophyll-a. In the study area, relative stabilities were chlorophyll-a > chlorophyllide-C2 > chlorophyllide-C1. Chlorophyll-b was present only in trace quantities and was observed to be stable down to 10 mm in depth. In the upper sedimentary layers, bacteriochlorophyll-a and bacteriopheophytin-a levels were found to be stable throughout the

depth profile and inversely proportional to one another. Depth profile results on chlorophyll-a derivatives including pheophytin-a gave no evidence that these compounds were intermediates of chlorophyll-a degradation in the environment examined. With greater depth, further degradation of chlorophyll-a to colorless products occurred, presumably in intact algal cells. (Geiger-FRC)
W81-00951

2K. Chemical Processes

THE EFFECT OF DISSOLUTION OF VOLCANIC GLASS ON THE WATER CHEMISTRY IN A TUFFACEOUS AQUIFER, RAINIER MESA, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
A. F. White, H. C. Claassen, and L. V. Benson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $2.25. Geological Survey Water-Supply Paper 1535-Q, 1980. 34 p, 11 Fig, 5 Tab, 36 Ref.

Descriptors: *Water chemistry, *Geochemistry, Hydrogeology, Aquifer characteristics, *Groundwater movement, Chemical reactions, Kinetics, Rhyolites, Zeolites, Ion exchange, Adsorption, Nevada, *Volcanic glass, *Tuffaceous rocks, *Rainier Mesa(NV), Nevada test site.

Geochemistry of ground water associated with the Tertiary tuffs within Rainier Mesa, southern Nevada, was investigated to determine the relative importance of glass dissolution in controlling water chemistry. Water samples were obtained both from interstitial pores in core sections and from free-flowing fractures. Cation compositions showed that calcium and magnesium decreased as a function of depth in the mesa, as sodium increased. The maximum effect occurs within alteration zones containing clinoptilolite and montmorillonite, suggesting these minerals effectively remove bivalent cations from the system. Comparisons are made between compositions of ground waters found within Rainier Mesa that apparently have not reacted with secondary minerals and compositions of waters produced by experimental dissolution of vitric and crystalline tuffs which comprise the principal aquifers in the area. The two tuff phases have the same bulk chemistry but produce aqueous solutions of different chemistry. Rapid parabolic dissolution of sodium and silica from, and the retention of potassium within, the vitric phase verify previous predictions concerning water compositions associated with vitric volcanic rocks. Parabolic dissolution of the crystalline phase results in solutions high in calcium and magnesium and low in silica. Extrapolation of the parabolic dissolution mechanism for the vitric tuff to long times successfully reproduces at comparable pH, cation ratios existing in Rainier Mesa ground water. Comparison of mass-transfer rates of the vitric and crystalline tuffs indicates that the apparent high glass-surface to aqueous-volume ratio associated with interstitial permeability may account for dominance of the glass reaction. (USGS)
W81-00831

QUANTIFYING THE EUTROPHICATION PROCESS: DIFFICULTIES CAUSED, FOR EXAMPLE, BY SEDIMENTS,
H. Golterman.
Progress in Water Technology, Vol 12, No 2, p 63-80, 1980. 5 Fig, 22 Ref.

Descriptors: *Eutrophication, *Lakes, *Rivers, *Limnology, Model studies, Sediments, Aquatic environment, Water chemistry, Water properties, Algal control, Algae.

Even though present day information regarding the processes of eutrophication and their outcome is not complete, initial steps must be taken toward maintaining water quality. Knowledge is presently available to provide practical guidance for policy makers. The limitations of the models presently available are reviewed. The relation between algal biomass or algal growth rate and nutrients may be described using two separate submodels. The first deals with the relation between nutrient input and nutrient concentration. The second deals with the relation between nutrient concentration and algal growth. The adsorption model and the loading plus algal biomass model may also be employed. While each of these models is acceptable for a particular circumstance, a much greater understanding of the background mechanisms must be attained before conceptual models can be generated. (Baker-FRC).
W81-00863

EUTROPHICATION IN RELATION TO THE LOAD OF POLLUTION,
Uppsala Univ. (Sweden). Inst. of Limnology.
T. Ahl.
Progress in Water Technology, Vol 12, No 2, p 49-61, 1980. 10 Fig, 1 Tab, 30 Ref.

Descriptors: *Eutrophication, *Limnology, *Precipitation(Atmospheric), *Nutrients, Oligotrophy, Water properties, Water quality, Lakes, Geomorphology, Soiltypes.

Eutrophication is defined as a process which leads to nutrient-rich conditions in a body of water, regardless of the biological effects of such enrichment. In most cases such an enrichment will lead to increased biological activity. However, in cases of toxic enrichment, the effect will be opposite. Increases in nutrient load can result from precipitation and atmospheric deposition, from the soil, or from sources related to man's activities. The geographic distribution of the wet fallout of total nitrogen is described for 1968-1969 and compared with 1958-1959. While the wet deposition of phosphorus is not as well known, some data are presented. The terrestrial contribution of undisturbed soil to nutrients in a lake is influenced by climate, type of soil, topography, and vegetation. Disturbances of soil can alter the contribution of the area to the nutrients in nearby lakes. Such disturbances would include the use of inorganic fertilizers, cultivation of soil and other activities. Point sources of nutrients to the water come from urban areas and result from discharge of untreated domestic sewage and other activities. The annual discharge of nitrogen from Swedish industry has been estimated at 10,400 tons. If the average N/P ratio in industrial waste water is 7.5, this would yield a phosphorus discharge of 1,500 tons/yr. Studies indicated that the difference between a nutrient load giving oligotrophic conditions and one giving eutrophic conditions is much greater than would be suggested by the total amounts of nutrients involved. (Baker-FRC)
W81-00883

2L. Estuaries

TRENDS IN COASTAL WASTE TREATMENT,
WAPORA, Inc., Chevy Chase, MD.
For primary bibliographic entry see Field 5D.
W81-00891

THE APPLICATION OF AN ECOSYSTEM MODEL TO THE BRISTOL CHANNEL AND SEVERN ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
P. J. Radford, and I. R. Joint.
Water Pollution Control, Vol 79, No 2, p 244-254, 1980. 8 Fig, 7 Ref.

Descriptors: *Model studies, *Channels, *Estuaries, Aquatic ecosystems, Recycling, Nutrients, Environmental effects, Pollutants, On-site data collections, Monitoring, Data collections, Bristol channel, Severn estuary, England.

The formulation and application of the GEMBASE model, an ecosystem model describing the Bristol Channel and Severn Estuary, are presented. Research in the channel, data from the literature, and laboratory experiments were used to derive the model. The model showed that the riverine input of nutrients was not sufficient to support the observed primary production rate and that local nutrient recycling must occur. Nutrient regeneration studies in the Carmarthen Bay have commenced as a result of model information. GEMBASE will also be utilized to answer applied problems and to predict the consequences of building a tidal barrage on the channel ecosystem. Expansions on the model could be used to evaluate the effects of pollutants on the ecosystem where data on effects already exist. The hydrodynamic subsystem would simulate the distribution of any conservative pollutant and, if the relationship is known between a pollutant's concentration and its biological effect, the effect on the entire ecosystem could be simulated. Data collected from 1977 to 1981 on monitoring cruises in the British Channel will be used to validate the verified version of GEMBASE. (Geiger-FRC)
W81-00907

INPUT AND EARLY DIAGENESIS OF CHLOROPHYLLS IN A TEMPERATE INTERTIDAL SEDIMENT,
Melbourne Univ., Parkville (Australia), Dept. of Organic Chemistry.
For primary bibliographic entry see Field 2I.
W81-00951

EFFECTS OF ALTERED FRESHWATER INFLOW ON ESTUARINE SYSTEMS,
Texas Univ. at Austin. Environmental Health Engineering Lab.
N. E. Armstrong.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 17-31. 6 Fig, 9 Ref. 14-16-0002-79-152.

Descriptors: *Estuaries, *Freshwater, *Inflow, *Water quality, Ecology, Flow, *Environmental effects, Salinity, Mathematical models, Productivity, Spatial distribution, Temporal distribution, Biota, Commercial fishing.

There are three critical elements in this framework for determining freshwater release needs for estuarine systems. The first is the determination of appropriate water quality levels needed to sustain the diversity and productivity of the bay system, particularly commercially important species. The second is the process or predictive basis by which the effects of spatial and temporal distributions of freshwater flows are determined. The third is the determination of the quality and scheduling of freshwater inflows. Studies have related inflows to biological changes in estuaries using the community approach, the population approach, and the individual approach. The method chosen for such studies should be a function of the data available for the analysis. By exercising mathematical models for the system being studied, freshwater inflows may be correlated with changes in water quality at any point. Using this information and estimates of freshwater inflows to the bay, the effects of changes in freshwater inflows can be determined. (Moore-SRC)
W81-00992

STUDIES OF FRESHWATER NEEDS OF FISH AND WILDLIFE RESOURCES IN NUECES-CORPUS CHRISTI BAYS, TEXAS,
Fish and Wildlife Service, Austin, TX.
N. A. Funicelli.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 97-102. 1 Tab, 4 Ref.

Descriptors: *Estuarine environment, *Inflow, *Freshwater, *Salinity, *Biota, Ecology, Texas, Wildlife, Development stages, Water chemistry, Fish, Nutrients, Water quality, Aquatic plants, Shellfish, Seasonal, Management, Sediments, Productivity, Seagrasses, *Nueces-Corpus Christi Bays(TX).

The proposed Choke Canyon Reservoir could adversely affect the productivity of the Corpus

Christi, Nueces estuarine system by reducing the inflows of fresh water, nutrients, and sediments. Plants were collected and production measured from September 1978 to June 1979 from 10 transects representative of the Nueces delta, Harbor Island and Mustang Barrier Island study areas. Dissolved nutrient parameters were monitored during diurnal sampling. Larval, post-larval, juvenile, and adult fish and shellfish were sampled at various stations in the seagrass beds. Physiochemical data were also collected at all stations. Live standing crop was highest during the late spring, summer, and early fall, and lowest during the winter months. Inorganic nutrient concentrations were typically higher in the Nueces Marsh than in the seagrass beds. Analysis of nutrient exchange data during the period October 1978 to June 1979 indicated that the net annual flow of all nutrients was into Nueces marsh. Analysis of fish data indicated decreased use of marsh habitat during the winter months. Preliminary study indicates that fresh water inflow management cannot be tied to salinity management in Nueces, Corpus Christi Bays. Fresh water inflow must be considered as a transport system for estuarine nutrients and a mechanism for flooding which allows optimum habitat utilization. (Moore-SRC)
W81-00996

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

THE INFLUENCE OF ACCELERATION AND FLOW ON CONCENTRATION POLARIZATION IN REVERSE OSMOSIS,
SRI International, Menlo Park, CA.
G. B. Andeen, and M. S. Colah.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134926. Final Report to Office of Water Research and Technology, November, 1980. 167 p, 17 Fig, 3 Tab, 16 Ref, 1 Append. OWRT-C-80364-S(No 9462)(1), 14-34-0001-9462.

Descriptors: *Reverse Osmosis, *Boundary layers, *Centrifugation, *Desalination processes, Testing procedures, Mass transfer, Evaluation, Concentration polarization, Acceleration.

'Concentration polarization' is the buildup of enriched brine at the membrane surface during reverse osmosis desalination. The usual techniques for limiting the buildup involve diffusion and flushing. The tests show that acceleration, as in a centrifuge, also can control the concentration polarization. Acceleration forces act preferentially on the enriched, more dense brine, pulling it from the membrane surface. Acceleration can also control flow distribution and reduce fouling. Hollow-fiber reverse osmosis elements were operated in a continuous flow centrifuge up to 1000 g. Increased flow and quality of desalted water indicated reduced concentration polarization under acceleration or increased brine flow. The effective mass transfer coefficient for removal of salt from the membrane surface was changed as much by doubling the acceleration as by doubling the flushing flow. Use of acceleration would allow use of higher transport rate membranes. This, together with fouling reduction, may make use of centrifuges in reverse osmosis economically attractive.
W81-00971

3B. Water Yield Improvement

MASS AND HEAT TRANSFER IN A CIRCULAR TUBE WITH BIOFOULING,
Rice Univ., Houston. Dept. of Chemical Engineering.
J. P. Kirkpatrick, L. V. McIntire, and W. G. Characklis.
Water Research, Vol 14, No 2, p 117-127, February, 1980. 14 Fig, 26 Ref.

Descriptors: *Mass transfer, *Heat transfer, *Fouling, *Mathematical models, Laminar flow, Microorganisms, Heat, Heat flow, Temperature, Heat exchangers, Fluid mechanics, Thermodynamics, Pipelines.

A phenomenological model for development of biofilm in a circular tube is presented, and its effect on heat transfer is examined under conditions of both laminar flow and turbulent flow. With laminar flow, radial mass transfer takes place solely by molecular diffusion, and with turbulent flow it takes place by both molecular and convective diffusion. Determination of heat transfer involves equations analogous to those for mass transfer, except that heat produced in the biofilm is assumed to be negligible and that a fluid is held at a constant temperature outside the tube. The presence of biofilm was found to decrease heat transfer significantly in both laminar and turbulent flow. As the thickness of the film increases in turbulent flow, there is a related change in the bulk concentration profile. For coupled heat and mass transfer, mass diffusivity, viscosity, and reaction rate are strongly temperature dependent. Biofilm thickness varies with fluid temperature. The results of the model are widely applicable in fouling systems. They suggest that for quantitative estimates of coupled heat and mass transfer, computations for particular parameters are necessary. (Titus-FRC)
W81-00789

3C. Use Of Water Of Impaired Quality

INSTITUTIONAL CONSTRAINTS ON ALTERNATIVE WATER FOR ENERGY, A GUIDEBOOK FOR REGIONAL ASSESSMENTS.
For primary bibliographic entry see Field 6E.
W81-00892

A PRELIMINARY SITE EVALUATION METHOD FOR TREATMENT OF MUNICIPAL WASTEWATER BY SPRAY IRRIGATION OF FOREST LAND,
Law Engineering Testing Co., Marietta, GA.
G. L. Taylor.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 22-33, 1980. 4 Tab, 12 Ref. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Land treatment, *Wastewater, *Waste treatment, *Irrigation waste water, *Hydrologic budget evapotranspiration, Percolation, Precipitation, Design criteria, Climactic data, Data collection, Topography.

Specific knowledge of the hydrologic and chemical interactions between soil, climate, topography, and vegetation is necessary to properly design land treatment systems and predict with some certainty the long-range impacts of the system. Land treatment system evaluation can be divided into two major phases: site evaluation and hydrologic budget evaluation, with the former being completed first. Seven primary factors are used to evaluate a site for land treatment and to determine if spray irrigation of wastewater can be utilized at a specific site. Nine secondary factors are also used to evaluate the site but are not as critical as site suitability. The hydrologic budget for a spray irrigation, land treatment site has four components: design precipitation, evapotranspiration, percolation of water to the groundwater, and wastewater hydraulic loading. Wastewater must be applied uniformly at the proper hydraulic loading and application rates for adequate renovation. Proper design and diligent management are critical. Unicoi State Park in southeastern United States was used to develop the design information base. Soil percolate samples have shown that the Park has been adequately renovating municipal wastewater for seven years. (Atkins-Omniplan)
W81-00932

SALINE CULTURE OF CROPS: A GENETIC APPROACH,
California Univ., Davis. Agricultural Experimental Station.
E. Epstein, J. D. Norlyn, D. W. Rush, R. W. Kingsbury, and D. B. Kelley.
Science, Vol 210, No 4468, p 399-404, October, 1980. 3 Fig, 3 Tab, 55 Ref.

Descriptors: *Salinity, *Irrigation practices, *Genetics, *Saline water, *Crop production, Water requirements, Irrigation water, Soil chemical properties, Barley, Wheat, Tomatoes, Osmotic pressure, Available water, Adaptation, Fruit crops, Salts, Sea water, Saline water intrusion.

Countries that depend upon irrigation of crops for agriculture are often faced with the problem of high levels of salts in irrigation and groundwater supplies. High salt levels in soils create high osmotic pressures, making water even less available to plants. Since engineering approaches to the problem of water supply salinity can only manipulate the environment to try to provide adequate irrigation water, often at high expense, it was suggested that a genetic approach involving the development of salt-tolerant plants be used to increase crop yields. Although saline soils exist in subhumid regions, they are most prevalent in arid and semi-arid regions. California suffers from high soil salinity in three agricultural valleys. Work done on salt-tolerant plants at the University of California includes experiments on various barley and wheat genotypes and some tomato cultivars. Preliminary results indicate that species tolerant to salt levels near that of sea water should be attained soon in crops of wheat and barley; however, salt-tolerant tomato plants suffer drastic reductions in fruit size and possess limited value for commercial use. Use of certain rhizobial fungi may enhance the salt tolerance of nitrogen-fixing legumes. Grafting techniques have been studied to increase salt-tolerance levels of woody plants and fruit trees. Research is presently being conducted on the mechanisms of salt tolerance in plants. Further work is needed on international collaboration and wild halophytes. Geographical, economic and social areas where research on saline crop culture would have the most benefits should also be considered. (Geiger-FRC)
W81-00953

RECYCLING OF SEWAGE EFFLUENT BY SUGARCANE IRRIGATION: A DILUTION STUDY, OCTOBER 1976 TO OCTOBER 1978, PHASE II-A,
Hawaii Univ., Honolulu.
S. L. Lau, P. C. Ekern, P. C. S. Loh, R. H. F. Young, and G. L. Dugan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144669, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center, University of Hawaii, Honolulu, Technical Report No 130, March, 1980. 3 Fig, 21 Tab, 39 Ref, 6 Append. 14-34-0001-3811.

Descriptors: *Sugarcane, *Sewage effluents, *Water reuse, Furrow irrigation, Viruses, On-site tests, Hawaii, Agriculture, Dilution(Wastes).

An extension of the project, 'Recycling of Sewage Effluent by Irrigation: A Field Study on Oahu.' This portion's objective was to determine the dilution with Waiahole Ditch water necessary for optimal sugar yield when chlorinated, secondarily treated sewage was used for irrigation of cane. Hawaiian sugarcane variety 59-3775 was planted to a random-block design of treatments with 6 replicates in central Oahu near the Mililani Sewage Treatment Plant. The 5 irrigation treatments for the two-cane cycle were: (1) ditch water; (2) 12.5%; (3) 25%; (4) 50% effluent diluted with ditch water; and (5) effluent the first year and ditch water the second. The ripener 'Polaris' was applied prior to harvesting. Crop logs monitored the cane growth and test plots were hand harvested for assessment of cane and sugar yield. Soil water percolate and sewage effluent were chemically analyzed to check for human enteric viruses. Sugar yields for effluent concentrations up 25%, or for effluent the first year and ditch water the second,

were equal to those from conventional ditch-water irrigation. There was a significant loss in juice quality and sugar yield for the 50% effluent concentrations. Immediately after each application of fertilizer and with effluent concentrations of 50 to 100%, the nitrate nitrogen concentrations in the percolate exceeded the critical level of 10 ppm for potable water. Total applications exceeded the sugarcane's ability to take up nitrogen; however, an apparent nitrogen deficit was assigned to gaseous nitrogen loss. No virus was recovered but 40% of the effluent reservoir samples were positive. At least 96% of the virus was inactivated after 1 day of storage. (Author's abstract)
W81-00981

3D. Conservation In Domestic and Municipal Use

DISTRIBUTION PATTERNS OF HOME LAWN SPRINKLERS,
Wyoming Univ., Laramie.
G. L. Kerr, L. O. Pochop, J. Borrelli, and D. A. Anderson.
Transactions of the ASAE, Vol 23, No 2, p 387-392, 1980. 1 Fig, 7 Tab, 8 Ref. OWRT B-035-WYO(8), 14-34-0001-7201.

Descriptors: *Lawns, *Sprinkler irrigation, *Application methods, Irrigation practices, *Water conservation, Irrigation efficiency, Municipal water, Testing procedures, Evaluation.

Distribution patterns of six typical lawn sprinkler types were determined during the summer of 1977. Tests were conducted on four sprinklers of each type under three pressure levels. Christiansen's Uniformity Coefficients (UCC) were calculated for the orginal pattern and for various overlaps of the sprinklers. Overlaps required to achieve minimum acceptable UCC values were then determined. The output of each sprinkler was measured and application rates were calculated for individual pattern sizes at the three pressure levels. Two important factors for effective lawn watering are: (1) use of the proper overlap for an individual sprinkler type, and (2) determining the application rate in order to apply the proper amount of water.
W81-00809

THE EVALUATION OF WATER CONSERVATION FOR MUNICIPAL AND INDUSTRIAL WATER SUPPLY: PROCEDURES MANUAL,
Planning and Management Consultants Ltd., Carbondale, IL.
For primary bibliographic entry see Field 6B.
W81-01000

3F. Conservation In Agriculture

WATER-CONSERVING WHEAT IRRIGATION SCHEDULES BASED ON CLIMATIC DATA,
Oklahoma Water Resources Research Inst., Stillwater.
M. B. Kirkham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143661, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, 1980. 40 p, 4 Append. OWRT-B-045-OKLA(1), 14-34-0001-9129.

Descriptors: *Oklahoma, *Irrigation efficiency, *Wheat, *Irrigation practices, Scheduling, Agriculture, Crop response, Irrigation programs, Water conservation, Semiarid climates, Rainfall, Plant growth, Groundwater, Climatic data.

Irrigation schedules were developed based on correlations between yield and rainfall for the Oklahoma area. Historical records show that wheat yields are best when rain falls within a five day interval in late March. Past irrigation scheduling did not call for water applications to begin until after April 1. The records used to develop the correlations were for spring rainfall and grain yield on winter wheat grown between 1960 and 1977 at Stillwater and Goodwell, Oklahoma. Dates of high correlation were identified and field plots were established to test the resulting revised irrigation schedule. The revised schedule called for 15.2 cm of water applied in 7.6 cm increments on March 20 and April 24. The other schedule, the normal schedule, called for 22.8 cm of water applied in 7.6 cm increments on March 20, April 3, and April 24. A control of plants grown dryland was also used. To quantify plant water stress, plants were monitored for water potential, osmotic potential, stomatal resistance, and leaf temperature. Results show that greater water-use efficiency and higher yields were obtained with the revised irrigation schedule. Four related publications resulting from Office of Water Resources and Technology funding are attached. (Seigler-IPA)
W81-00811

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A SYSTEMS APPROACH TO SOLVING RESOURCE ALLOCATION PROBLEMS WITH MULTIPLE OBJECTIVES,
California Univ., Los Angeles. Dept. of Engineering Systems.
G. A. O'Keefe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-140683, Price codes: A04 in paper copy, A01 in microfiche. M.S. Thesis, 1980. 45 p, 5 Fig, 8 Tab, (California Water Resources Center Project UCAL-WRC-W-576). OWRT-A-077-CAL(1).

Descriptors: *Resource allocation, *Model studies, *Economics, *Conjunctive use, Water management(Applied), Water storage, Water supply, Optimum development plans.

A resource allocation program is developed to assist in basin management where there are multiple objectives. The problem involves the allocation of: (1) water from groundwater and imported supplies to the users of a watershed, (2) wastewater from each user to the treatment plants of the region, and (3) treated water from the treatment plants to the disposal sites. The objectives which are of concern are minimization of the total cost of transporting and treating the water, and optimization of the water quality in the groundwater basin. The program consists of a simulation model, a single objective optimization model and a modification subroutine. The simulation model utilizes the Gauss-Seidel method of finite differences to solve the governing equations for groundwater flow and mass transport. Flow values for this model are obtained from the allocation pattern derived from the single objective optimization. The output from the simulation model is the final water levels and quality for the given allocation plan. An iterative procedure is then used to generate further allocation plans. This is done by varying the coefficients of the objective function in a consistent pattern so that an improvement in the second objective is obtained at each step. Three separate modification procedures are developed and tested, each one utilizing a different method to update the objective function. All three methods were found to be similar in their final results, the only major difference being rates of convergence and total cost. The program is tested on a hypothetical basin set up for this project, using each of the modification processes. All three methods traced the identical solution. (Snyder-Calif)
W81-00751

EXPANDED FLOOD PLAIN INFORMATION STUDY WILLOW, ALASKA.
Corps of Engineers, Anchorage, AK. Alaska District.
Report, June, 1980. 112 p, 11 Fig, 4 Tab, 23 Ref, 7 Append.

Descriptors: *Flood plains, *Flood forecasting, *Land use, *Urbanization, Planning, Flood damage, Flood stages, *Alaska, Computer models, Watershed management, Economic impact, Hydrologic aspects, Environmental effects, Habitats, Maps.

The Willow Creek area is the proposed site for a new capital city for Alaska. Hydrologic, economic and environmental information were developed for use as a decision framework for State and local officials relative to the implications of land use change, based on the existing (1978) land use condition and two assumed land use conditions. Three flood plain regulatory policies were also evaluated to determine their effects on future flood damage potential. A data management and comprehensive analysis system was developed for this area. The system is not limited to flood plain management aspects, but is also capable of addressing many other aspects of Water Resource Planning. The analyses centered on the use of a computerized grid cell data bank containing spatially specific data. The future land uses in the Willow Creek basin will increase the frequency and the depth of flooding. Encroachment on the flood plain will also increase flood stages and flood damages. Future flood damages can be reduced if future construction allows for the hydrologic effects of that development. Increased growth pressures will cause a conversion from rural to urban habitat types. Therefore, there will be a decrease in number and diversity of species and stability of community types. (Moore-SRC)
W81-00757

AQUATIC PESTS ON IRRIGATION SYSTEMS, IDENTIFICATION GUIDE,
Water and Power Resources Service, Denver, CO.
N. E. Otto, T. R. Bartley, and J. S. Thullen.
Available from Supt. of Documents, GPO, Washington, DC 20402. A Water Resources Technical Publication, Second Edition, 1980. 96 p, 37 Fig, 26 Ref.

Descriptors: *Irrigation systems, *Invertebrates, *Aquatic weeds, *Phreatophytes, *Nuisance algae, Aquatic plants, Submerged plants, Aquatic animals, Floating plants, Weeds.

Extensive infestations of obnoxious plants and certain aquatic animals cause problems on irrigation systems, such as reduction in carrying capacity of the system, increased evaporation and seepage, clogging of structures, adverse environmental impacts, and water loss through transpiration. This simplified identification guide was prepared in response to requests from irrigation project operators and other personnel involved with biological problems requiring identification aids. An illustration and narrative description are provided for some of the commonly observed organisms that become pests of irrigation systems in the Western United States. Submersed aquatic weeds, algae, floating aquatic weeds, emersed aquatic weeds, marginal weeds, woody plants (phreatophytes), and invertebrate aquatic animals are included. The illustrations include drawings of the entire organism, with inserts to depict key identifying features. (Moore-SRC)
W81-00760

THE EFFECT OF PHOTOCHEMICAL TREATMENT OF WATER ON ALGAL GROWTH,
Volcani Inst. of Agricultrual Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. J. Acher, and A. Elgavish.
Water Research, Vol 14, No 5, p 539-543, May, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Algae, *Growth rates, *Dyes, *Chlorophyta, *Dinoflagellates, Phytoplankton, Water quality, Lakes, Eutrophication, Laboratory tests, Solar radiation, Toxicity.

The effects of various concentrations of dye-sensitizer at different sunlight exposure times on the destruction of algae in batch cultures of three algae from Lake Kinneret were determined. The Lake is subject to algal blooms which impair its water quality, thus algal destruction was desirable. Peridinium, Pediastrum, or Cosmarium were inoculated in an artificial medium containing either rose

bengal (RB) or methylene blue (MB) and incubated in a controlled environment (20 plus or minus 2C, 14 hr light, 10 hr dark) for about 35 days. Some of the samples were sunlight-irradiated for intervals of 10-120 min prior to incubation. In Pediastrum cultures, the addition of 0.40 mg MB/liter or 1.50 mg RB/liter resulted in the complete destruction of algae after 7 days. The Peridinium cultures were destroyed with 0.50 mg MB/liter of 2.0 mg RB/liter after 15 to 25 days. In Cosmarium cultures 0.75 mg MB/liter of 1.20 mg RB/liter was required for algal destruction in 20 days. For Pediastrum and Peridinium, the dye concentrations necessary to achieve complete algal destruction in cultures exposed to sunlight were about half those required in cultures not subjected to solar radiation. In the case of Cosmarium, the MB concentrations were the same with or without sunlight exposure, but the incubation time for algal destruction was about half. In all experiments performed, MB showed a greater algicidal effect than RB. (McKeon-FRC)
W81-00771

AERATION AS A TOOL TO IMPROVE WATER QUALITY AND REDUCE THE GROWTH OF HYDRILLA,
University of South Florida, Tampa.
T. N. Cooley, P. M. Dooris, and D. F. Martin.
Water Research, Vol 14, No 5, p 485-489, May, 1980. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Model studies, *Aquatic weed control, *Aeration, *Water quality, *Nutrients, Lakes, Freshwater, Rooted aquatic plants, Aquatic weeds, Submerged plants, Bubbles, Oxygenation, Nitrogen, Carbon, Iron, Phosphorus, Calcium, Hydrogen ion concentration, Zinc, Magnesium, Trace metals, Essential nutrients, Plant growth, Water pollution.

The effects of aeration upon the macronutrients carbon, nitrogen, phosphorus, iron, calcium, and magnesium and some trace elements were examined in a model lake system. The use of aeration as a technique for the control of the aquatic rooted submerged plant Hydrilla verticillata was also examined. This plant has been recognized in Florida as a nuisance weed since the mid 1960's. Growth of Hydrilla was reduced by 20% fresh weight and 18% dry weight after an average of 21 days of aeration. Decrease in Hydrilla growth was attributed to oxygenation of the water and not the mechanical action of bubbling, as shown in studies with bubbles of pure nitrogen. Aeration caused a deterioration in general water quality. Aeration decreased inorganic carbon and nitrate-nitrite-nitrogen levels, while it caused elevations in dissolved oxygen levels and pH. No effects due to aeration were found on phosphate-phosphorus levels; however, decreases were noted in the concentrations of calcium, iron and zinc. After 7 days of aeration, iron levels decreased to less than 20 ppb. Iron depletion was significantly correlated with reduction of Hydrilla growth, and iron deficiency was suspected as the limiting factor in the model lake-Hydrilla system. (Geiger-FRC)
W81-00961

EFFECTS OF CHANGES IN SURFACE WATER REGIME AND/OR LAND USE ON THE VERTICAL DISTRIBUTION OF WATER AVAILABLE FOR WETLAND VEGETATION, PART I, DYNAMIC MODEL OF THE ZONE OF AERATION,
Arkansas Water Resources Research Center, Fayetteville.
R. N. MacCallum.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-145047, Price codes: A04 in paper copy, A01 in microfiche. Project Technical Completion Report, Publication No 70, June, 1980. 60 p, 7 Fig, 6 Tab, 51 Ref, 4 Append. OWRT-A-023-ARK(3).

Descriptors: *Mathematical models, *Wetlands, *Zone of aeration, *Algorithms, *Vegetation, *Arkansas, Kansas, Computer models, Groundwater movement, Hydrologic models, Model studies, Research and development, Mathematical studies, Mathematics, Vegetation effects, Hydrologic aspects, Hydrology, Planning, Seasonal, Transpiration, Precipitation(Atomspheric).

The primary objective of this study was to develop a dynamic mathematical model of the zone of aeration fo wetlands which describes the vertical distribution of water available for use by vegetation. A mathematical model reported by Green, Dabin, and Khare for simulating one-dimensional vertical groundwater movement in unsaturated soils of the Kansas prairie region, was adapted for use in a wetlands environment, typified by the Eastern Arkansas wetlands forest. The adapted model consisted of two second-order non-linear partial differential equations, and an algorithm for their numerical solution. The original model was extended to include functions for seasonal changes in transpiration and for drainage of excess precipitation. Prior to the addition of these two functions, model reliability was limited to one growth season. Interactions between hydrologic changes and long-term vegetative changes can be studied with the model. The model provides a potentially versatile management tool to assist prediction of the environmental impact of proposed flood control projects. The model was programmed for the IBM System 360 computer, and theoretical data pertinent to the Arkansas Delta region was developed. (Zielinski-IPA)
W81-00968

THE NATURE AND EFFECTS OF COUNTY DRAINAGE DITCHES IN SOUTH CENTRAL MINNESOTA,
Mankato State Univ., MN. Dept. of Biological Sciences.
H. W. Quade, K. W. Boyum, D. O. Braaten, D. Gordon, and C. L. Pierce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-135451, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota St. Paul, Bulletin Number 105, November, 1980. 135 p, 10 Fig, 47 Tab, 42 Ref. OWRT-A-040-MINN(7).

Descriptors: *Drainage effects, *Water quality, *Nutrients, *Sediment transport, *Minnesota, Rivers, Ditches, Runoff, Sediment distribution, Nutrient loading, Fluvial geomorpholoy, Nonpoint source pollution, Riparian Green Belt, Blue Earth County(MN), Le Sueur County(MN), Nicollet County(MN), Brown County(MN).

The extent of county drainage was determined for four counties in South Central Minnesota followed by a study of the gemorphic nature of man's drainage in contrast to natural drainage. Selected drainage ditches and low order rivers were sampled for water quality and quantity in order to determine the contributions and timing of nutrient loads from each. Seventy-nine percent of the drainage ditches were found to terminate into rivers and they more than doubled the length of the surface fluvial systems. The closeness of fit of the drainage ditch systems to the low order Strahler classification scheme suggests that man has taken an immature lake-marsh environment and within 100 years created a geomorphically mature fluvial landscape. Nutrient loading by ditches into receiving bodies was found to vary by season, by individual ditch or river, and by stream order indicating that each ditch was unique. Water quality of one ditch during this wet study year was compared to a previous dry year study and the nutrient loading data was consistent and predictable. The most significant loading nutrient chemical parameter to the Minnesota River was found to be nitrate-nitrogen. Flow showed flashy response to storm events in some ditches and some were quite conservative. Sediment load was directly correlated to flow.
W81-00976

4B. Groundwater Management

A COMPARISON OF ANALOG AND DIGITAL MODELING TECHNIQUES FOR SIMULATING THREE-DIMENSIONAL GROUNDWATER FLOW ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-00830

GROUND-WATER CONDITIONS AT BEALE AIR FORCE BASE AND VICINITY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. W. Page.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.75 in paper copy, $5.00 in microfiche. Geological Survey Open-File Report 80-204, April, 1980. 36 p, 7 Fig, 3 Plates, 12 Tab, 44 Ref.

Descriptors: *Groundwater resources, *Water quality, *Hydrogeology, *Aquifer characteristics, *California, Groundwater movement, Well data, Pumping, Water levels, Water supply, Water yield, chemical analysis, *Beale Air Force Base(CA), *Eastern Sacramento Valley(CA).

Ground-water conditions were studied in a 168-square-mile area between the Sierra Nevada and the Feather River in Yuba County, Calif. The area is in the eastern part of the Sacramento Valley and includes most of Beale Air Force Base. Source, occurrence, movement, and chemical quality of the ground water were evaluated. Ground water occurs in sedimentary and volcanic rocks of Tertiary and Quaternary age. The base of the freshwater is in the undifferentiated sedimentary rocks of Oligocene and Eocene age, that contain water of high dissolved-solids concentration. The ground water occurs under unconfined and partly confined conditions. At Beale Air Force Base it is at times partly confined. Recharge is principally from the rivers. Pumpage in the study area was estimated to be 129,000 acre-feet in 1975. In the 1960's, water levels in most parts of the study area declined less rapidly than in earlier years or became fairly stable. In the 1970's, water levels at Beale Air Force Base declined only slightly. Spacing of wells on the base and rates of pumping are such that excessive pumping interference is avoided. Water quality at the base and throughout the study area is generally good. Dissolved-solids concentrations are 700 to 900 milligrams per liter in the undifferentiated sedimentary rocks beneath the base well field. (USGS)
W81-00832

GROUND WATER OVERDRAFTING MUST BE CONTROLLED.
General Accounting Office, Washington, DC.
Available from Supt. of Documents, GPO, Washington, DC 20402. Comptroller General's Report to the Congress, CED-80-96, September 12, 1980. 56 p, 7 Append.

Descriptors: *Overdraft, *Groundwater mining, *Water management(Applied), *Groundwater resources, Saline water intrusion, Aquifers, Water conservation, Water resources development, Water demand, Land subsidence, Surface-groundwater relationships, Pumping, Planning.

The demand for water in many areas of the country is being met by overdrafting ground water. Overdrafting is most serious in the arid and semiarid western states where irrigation of crops accounts for over half of all ground water use. Subsidence caused by overdrafting has caused millions of dollars in damage to surface structures. In coastal areas where ground water levels are lowered by overdrafting the normal flow of freshwater to the ocean is reversed, and salt water moves into freshwater areas. In inland aquifers intrusion may occur when salt water migrates vertically and horizontally into freshwater aquifers. Where surface streams and rivers are geologically interrelated with the underlying ground water aquifers, surface flow may be reduced by overdrafting. When a ground water aquifer is continually overdrafted, the level of the aquifer declines, and more energy is required to pump the water from greater depths. It is recommended that the Congress direct the Departments of Agriculture, the Army, and the Interior to require that affected states and commu-

nities implement or have plans to implement a program for controlling ground water pumping, and a conservation program before the start of federally funded water resources or ground water mitigation projects. (Moore-SRC)
W81-00990

4C. Effects On Water Of Man's Non-Water Activities

STREAM-WATERSHED RELATIONSHIPS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Univ.-Columbia.
M. M. Smart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143398, Price codes: A09 in paper copy, A01 in microfiche. PhD Dissertation, August, 1980. 170 p, 12 Fig, 22 Tab, 94 Ref. OWRT-A-111-M0(1), 14-34-0001-9027.

Descriptors: *Land use, *Effects, *Water quality, Streams, Water chemistry, *Watersheds(Basins), *Missouri, Urban drainage, Pastures, Forest watersheds, Evaluation.

Land use is the most influential watershed characteristic determining chemical concentrations of 23 streams that drained watersheds with different land uses, geologic bedrock, and soil associations in the Missouri Ozark Plateau Province. Streams draining watersheds with urban land use had the highest chemical concentrations and streams draining forest watersheds the lowest. Streams draining pasture watersheds were intermediate, more closley resembling streams in overall salinity, and urban streams in nitrogen and phosphorus. Nutrient concentrations increase along a continuum in response to the area of urban or pasture area on the watershed and decrease with increasing forest area. Algal biomass was governed by plant nutrients, streamflow, and morphological characteristics of the stream. Planktonic biomass was determined by TP and NH sub 3-N and is derived from benthic populations. Prediction of stream chemical concentrations and algal biomass from watershed land use can be used to assess changes in streams that may occur as the result of changes on the watershed.
W81-00803

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
J. R. Jones, and M. M. Smart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-149635, Price codes: A07 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri, Completion Report, November, 1980. 140 p, 7 Fig, 16 Tab, 94 Ref, 2 Append. OWRT-A-111-MO(2), 14-34-0001-9027 & 0127.

Descriptors: *Land use, *Environmental effects, *Ecology, *Watersheds(Basins), *Missouri, Water pollution sources, Urban runoff, Forests, Pastures, Nutrients, Dissolved solids, Streamflow, Non-point sources, Streams, *Missouri Plateau Province.

Land use is the most influential watershed characteristic determining chemical concentrations of 23 streams that drained watersheds with different land uses, geologic bedrock, and soil associations in the Missouri Ozark Plateau Province. Streams draining watershed with urban land use had the highest chemical concentrations and streams draining forest watershed the lowest. Streams draining pasture watersheds were intermediate, more closely resembling streams in overall salinity, and urbans streams in nitrogen and phosphorus. Nutrient concentrations increase along a continuum in response to the area of urban or pasture area on the watershed and decrease with increasing forest area. Algal biomass was governed by plant nutrients, streamflow, and morphological characteristics of the stream. Planktonic biomass was determined by TP and NH3 -N and is derived from benthic populations. Prediction of stream chemical concentrations and algal biomass from watershed land use can be used to assess changes in streams that may occur as the result of changes on the watershed.
W81-00978

MANAGING IMPACTS OF PETROLEUM DEVELOPMENT IN BRACKISH MARSHES,
General Land Office of Texas, Austin.
For primary bibliographic entry see Field 5C.
W81-00998

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATION OF PROCEDURES FOR RECOVERY OF VIRUSES FROM WATER-II. DETECTION SYSTEMS,
Severn Trent Water Authority, Coventry (England). Regional Lab.
R. Morris, and W. M. Waite.
Water Research, Vol 14, No 7, p 795-798, July, 1980. 3 Tab, 15 Ref.

Descriptors: *Viruses. *Rivers, *Monitoring, Cultures, Pollutant identification, Cytological studies, Aquatic environment, Water pollution, Testing procedures, Laboratory tests.

The feasibility of one human and two monkey cell systems in monolayers in tubes and flasks and in agar-suspended cells for detecting enteroviruses in river water samples was examined in laboratory tests. Monkey Vero cells proved to be inefficient for the detection of viral pollution. The Buffalo green monkey (BGM) cells generally gave the best recoveries, while the results of virus recovery using the human rhabdomyosarcoma (RD) cells were variable. Cell culture presentation played a major role in the efficiency of viral recovery. Agar suspensions afforded the best recovery of viruses from water samples, followed by tube cultures of cells, then by cell monolayers in flasks. Tests performed on water from the River Sowe using the BGM-agar suspended cell system yielded virus levels varying from 145 to 620 plaque-forming units/liter. The same test method used on the River Avon showed that much lower virus concentrations were present in this river, with an occasional high count of 540 plaque-forming units/liter being detected. It was concluded that BGM- and RD-agar suspended cells were satisfactory for the routine monitoring of aquatic environments. (See also W81-00766) (Geiger-FRC)
W81-00767

THE ANALYSIS AND FATE OF ODOROUS SULFUR COMPOUNDS IN WASTEWATERS,
Los Angeles County Sanitation Districts, Whittier, San Jose Creek Water Quality Lab. CA.
For primary bibliographic entry see Field 7B.
W81-00776

OBTAINING PRECISE ESTIMATES IN COLIFORM ENUMERATION,
College of Staten Island, NY. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W81-00782

ATP AS AN INDICATOR OF TOXICITY,
Texas A and M Univ., College Station. Dept. of Oceanography.
M. C. Kennicutt, II.
Water Research, Vol 14, No 4, p 325-328, April, 1980. 6 Fig, 7 Ref.

Descriptors: *Adenosine triphosphate, *Bioindicators, *Water pollution sources, *Pollutant identification, Aquatic ecosystems, Monitoring, Aquatic life, Toxicity, Sterilants, Organic compounds, Laboratory tests, Analytical techniques, Bioassay, Hydrogen ion concentration.

As previous studies of sewage sludge and water purification techniques had suggested that adenosine triphosphate was a potential candidate as a toxicity indicator, the value of ATP as an indicator of aquatic environmental pollution was examined in laboratory tests. The use of different chemicals for aquatic sample sterilization was also studied. ATP levels were measured using the luciferin-luciferase technique, and the toxins tested were chloroform, acetone, acrolein, and mercuric chloride. Chloroform at 5 ppm induced a 40% reduction in ATP levels after 6 hr of exposure. Mercuric chloride at 1 ppm induced 100% loss of ATP in only 1 hr. Reductions of ATP levels by highly acidic or highly basic pH values were also demonstrated. Since all living organisms contain ATP, the use of this compound as a sensitive indicator of potential pollutants in aquatic environments is recommended for routine use in conjuction with other lethal and sublethal tests for determining aquatic toxicity. The ATP tests also offer rapid results and can be used on a variety of natural waters provided pH parameters are taken into account. Mercuric chloride was preferred over chloroform as an agent to sterilize aquatic samples. (Geiger-FRC)
W81-00783

REDUCTION OF COLIFORM BACTERIA IN TWO UPLAND RESERVOIRS: THE SIGNIFICANCE OF DISTANCE DECAY RELATIONSHIPS,
Leeds Univ. (England). School of Geography.
D. Kay, and A. McDonald.
Water Research, Vol 14, No 4, p 305-318, April, 1980. 7 Fig, 10 Tab, 42 Ref.

Descriptors: *Reservoirs, *Coliforms, *Fluctations, Theoretical analysis, Self-purification, Rainfall, Surface waters, Water quality, Pathogenic bacteria, Limnology, Land use, *England.

Two British upland reservoirs with multiple-use catchment areas were studied from September 1976 to September 1977 for coliform bacteria densities. The catchment-use level is defined in terms of recreation and agriculture. Purification rates for the reservoirs were calculated for different limnological conditions. Results showed that peak loadings of bacteria would occur following heavy rainfalls when waters fill depleted reservoirs. A model is presented that utilizes logarithmic bacterial decay to estimate self-purification by the reservoir. Reduction of coliform bacteria in other reservoirs was examined for comparison. Results indicated that the distance-decay relationships presented were applicable only to the individual impoundment for which they were calculated. The distance-dependent decay function may serve as a useful concept for the catchment manager, to predict not the exact outlet coliform levels but the order of magnitude of purification that could be expected. (Geiger-FRC)
W81-00785

A PRESSURIZED PROPORTIONAL DILUTER FOR AQUATIC TOXICOLOGICAL STUDIES,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W81-00795

ZOOPLANKTON GRAZING AS A CONTROL MECHANISM IN ALGAL BLOOMS. A METHOD FOR THE STUDY OF THE EFFECT OF ALGAL TOXINS ON ZOOPLANKTON VERTICAL MIGRATION,
New Hampshire Univ., Durham. Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W81-00804

ANALYSES OF WATER AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1976-78,
Geological Survey, Baton Rouge, LA. Water Resources Div.
G. R. Stallworth, and H. F. Jordan.
Available from the OFSS, USGS Box 25425, Fed.

Ctr., Denver, CO 80225, Price: $20.75 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 80-694, June, 1980. 141 p, 9 Plates, 12 Tab, 12 Ref.

Descriptors: *Chemical analysis, *Water analysis, *Dredging, *Environmental effects, *Inland waterways, Water quality, Louisiana, Gulf of Mexico, Basic data collections, Biochemical oxygen demand, Chlorophyll, Coliforms, Effluents, Nutrients, Pesticides, Trace elements, Southern Louisiana waterways.

The U.S. Geological Survey was requested by the U.S. Army Corps of Engineers to provide water-quality data to evaluate the potential environmental effects of (1) dredging activities in selected navigable waterways of southern Louisiana and (2) the disposal of dredged material at selected areas in the Gulf of Mexico. Areas studied from September 1976 to May 1978 included five ocean disposal sites in the Gulf of Mexico, in addition to the following waterways: Baptiste, Collette Bayou, Mississippi River at Head of Passes and Southwest Pass, Mississippi River at Tiger Pass, Bayou Black, Intracoastal Waterway (Port Allen to Morgan City), and Calcasieu River and Ship Channel. Samples were analyzed for selected chemical, physical, and biological constituents. (USGS)
W81-00836

SEMI-QUANTITATIVE DETERMINATION OF FULVIC ACID, TANNIN AND LIGNIN IN NATURAL WATERS,
National Water Research Inst., Burlington (Ontario).
J. Lawrence.
Water Research, Vol 14, No 4, p 373-377, April, 1980. 2 Fig, 4 Tab, 15 Ref.

Descriptors: *Spectrophotometry, *Lignins, *Fulvic acids, Organic compounds, Organic acids, Humic acids, Decomposing organic matter, Aromatic compounds, Water analysis, Wavelengths.

The simultaneous, semiquantitative determination of fulvic acid, tannin and lignin by ultraviolet spectrophotometry is described. Three different wavelengths are used to measure absorbance. Concentrations are calculated using an expanded form of Beer's Law. The method compares well to other analytical methods for naturally occurring organic compounds. The method has accuracy of less than 15% for fulvic acid, less than 30% for tannic acid and less than 50% for lignosulfonic acid. (Baker-FRC)
W81-00868

BIOLOGICAL MONITORING. PART I-EARLY WARNING SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr., and W. H. Van Der Schalie.
Water Research, Vol 14, No 9, p 1179-1196, September, 1980. 1 Tab, 165 Ref.

Descriptors: *Monitoring, *Reviews, *Water pollution, *Aquatic ecosystems, Pesticides, Waste disposal, Toxicity, Respiration, Nitrification, Environmental effects, Water pollution control, Public health, Fish toxins, Metals, Chlorinated hydrocarbon pesticides.

The first report focusing on early warning systems from a symposium on biological monitoring consisting of six separate reports is presented in a review format. Natural systems have been threatened by contamination with improperly disposed wastes, as was witnessed in large-scale incidents with mercury poisoning and Kepone (chlordecone) pollution. Many chemicals pose a threat to human health as potential carcinogens. Management programs for the disposal of wastes will be needed to assess the ecological impact of various compounds on the environment. Early warning systems will ideally have test organisms exposed in field or laboratory situations to toxins under continuous flow conditions. A physiological or behavioral parameter of the organism should be monitored by a device capable of sensing abnormal responses. Short term changes as opposed to chronic effects are monitored in early warning toxicity tests. Some tests that are applicable to early warning toxicity monitoring include bacterial ATP and porphyrin tests indicating changes in bacterial numbers, oxygen consumption tests, nitrification and various macroinvertebrate response tests. Effects of DDT, carbaryl and dieldrin on heart rate of fish have been investigated. Response times of aquatic organisms to various metals and pesticides including lindane, DDT, pentachlorophenol, endrin, chlordane and parathion are given. Three scenarios for regulation of specific toxicants are outlined which might be implemented for the control of waste disposal. (Geiger-FRC)
W81-00880

PRELIMINARY ESTIMATE OF MERCURY POLLUTION IN THE FRENCH MEDITERRANEAN (PROVENCE-COTE D'AZUR) BY STUDYING CONTAMINATION LEVELS IN SEDIMENTS AND BENTHIC ORGANISMS (PREMIERE ESTIMATION DE LA POLLUTION MERCURIELLE DU LITTORAL MEDITERRANEEN FRANCAIS (PROVENCE-COTE D'AZUR) PAR L'ETUDE DU DEGRE DE CONTAMINATION DES SEDIMENTS ET DES ORGANISMS BENTHIQUES),
Centre Universitaire de Luminy, Marseille (France).
H. Augier, G. Gilles, and G. Ramonda.
Progress in Water Technology, Vol 12, No 1, p 97-108, 1980. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Sea water, *Benthic fauna, *Mercury, *Bioindicators, *Effluents, Sewers, Water pollution, Cities, Sediments, Industrial wastes, Europe, Sewage, Spectrophotometry, Mediterranean, France.

Flameless atomic absorption spectrophotometry was used to determine mercury levels in marine sediments and benthic plants and animals in the French Mediterranean. Thus, the degree of mercury pollution was estimated. Three species were used as biological indicators of mercury pollution: the red alga Ceramium ciliatum, the marine phanerogam Posidonia oceanica, and the mussel Mytilus galloprovincialis. Highest mercury levels were found in the urban and industrial areas of Marseille and the Gulf of Fos. Mercury concentrations at the Cortiou sewer outfall reached 14.5 ppm in sediments, 0.73 ppm in the sea urchin, 2.90 ppm in the sea cucumber, and 51.50 ppm in the leaves of Posidonia oceanica. These results combined with others indicated that urban sewage, which contains industrial wastes, is a major source of pollution. The pollution, however, was not found to reach dangerous levels. (Small-FRC)
W81-00890

THE CAVTAT ACCIDENT: EVALUATION OF ALKYL LEAD POLLUTION BY SIMULATION AND ANALYTICAL STUDIES,
Istituto di Recercha sulle Acque Bari (Italy).
For primary bibliographic entry see Field 7B.
W81-00895

DETERMINATION OF POLYOXYETHYLENE ALKYL ETHER NON-IONIC SURFACTANTS IN WATERS AT TRACE LEVELS AS POTASSIUM PICRATE ACTIVE SUBSTANCES,
Trieste Univ. (Italy). Inst. di Merceologia.
L. Favretto, B. Stancher, and F. Tunis.
Analyst, Vol 105, No 1254, p 833-840, September, 1980. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Surfactants, *Chemical precipitation, *Testing procedures, *Chemical reactions, *Physical properties, Soaps, Detergents, Water pollution sources, Wastes, Analytical techniques, Chemical properties, Organic compounds, Trace elements.

A method for absolute determination of polyoxyethylene alkyl ether non-ionic surfactants is proposed, in which potassium picrate is used as a precipitating agent. Application of the method to both mono- and poly-disperse surfactants is considered, and the reactivity of these is compared with the reactivity of other p-tert-nonylphenyl surfactants. Non-ionic surfactants, which are widely used in household detergent formulas and derived from industrial production, occur in trace levels in waters receiving untreated urban liquid wastes. Potassium picrate was added to varying concentrations of surfactant. The organic layer was extracted with 1,2-dichloroethane, centrifuged, and the absorbance was measured at 378 nm against the reagent blank. In all instances, the results demonstrated the validity of Beer's Law at trace levels. In all cases a second extraction produced small but significant absorbance. It was shown that n-dodecyl and p-tert-nonylphenyl monodisperse surfactants display maximum slopes of the calibration curves, converging to a limiting value with increasing degrees of polymerization. In polydisperse surfactants, no maximum is observed, but they tend toward the same limit as monodisperse surfactants. This method is effective for surfactants with polyoxyethylene chains which are too short to be precipitated with conventional methods. (Titus-FRC)
W81-00898

SIMPLIFIED METHOD FOR THE DETERMINATION OF CADMIUM, CHROMIUM, COPPER, NICKEL, LEAD AND ZINC IN SEWAGE SLUDGE USING ATOMIC-ABSORPTION SPECTROPHOTOMETRY,
Severn-Trent Water Authority, Malvern (England). Malvern Regional Lab.
K. C. Thompson, and K. Wagstaff.
Analyst, Vol 105, No 1254, p 883-896, September, 1980. 1 Fig, 13 Tab, 34 Ref.

Descriptors: *Heavy metals, *Sewage sludge, *Spectrophotometry, Analytical techniques, Chemical analysis, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Separation techniques, Testing procedures, Sludge disposal.

The deposition of digested sewage sludge on land may increase levels of certain toxic metals in the soil. An accurate, safe, rapid and simple method for analysis of these metals is presented, using nitric acid digestion in 50 ml calibrated glass tubes for the routine atomic absorption determination of cadmium, chromium, copper, nickel, lead, and zinc. Both wet and dried sludge can be analyzed by this technique. The use of a calibrated tube has advantages over the conventional beaker digestion in respect to the amount of volumetric apparatus required, the ease of digestion and the amount of space needed. Other digestion reagents such as aqua regia, nitric acid-hydrogen peroxide and nitric acid-perchloric acid can also be used with this method. The fractions insoluble in nitric acid were not significant in relation to the disposal of sewage sludge on agricultural land. (Baker-FRC)
W81-00899

RAPID AND SENSITIVE SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF NITRATE IN RAIN WATER USING 3,4-XYLENOL,
Ibadan Univ. (Nigeria). Dept. of Chemistry.
O. Osibanjo, and S. O. Ajayi.
Analyst, Vol 105, No 1254, p 908-912, September, 1980.

Descriptors: *Spectrophotometry, *Nitrates, Rain water, Nitrites, Chlorides, Analytical techniques, Water pollution, Fertilizers, Monitoring, Separation techniques.

An improved spectrophotometric method for determining nitrate in rain water has been developed using 3,4-xylenol. The reagent is nitrated at 0 degrees in 80% sulfuric acid, and the nitration product is extracted into toluene. The excess reagent remains in the aqueous layer. The toluene layer is treated with sodium hydroxide solution to produce a colored sodium salt of nitrophenol. The absorbance of the colored complex is measured at 432 nanometers. No significant interferences occurred in the presence of chloride. Bromide caused interference at 1:100 levels and above, and nitrite at 1:10 and above. Bromide interferences could be corrected with additions of silver sulfate or mercury sulfate, and nitrite interference was corrected by addition of sulfamic acid. Percent recovery of nitrate from spiked samples ranged from 96 to

108%. The technique may also be used for routine determination of nitrate in soils, river sediments and mineral oils. (Geiger-FRC)
W81-00900

IDENTIFICATION OF CHRYSOTILE ASBESTOS BY MICRODIFFRACTION,
Dow Chemical Co., Midland, MI.
D. R. Beaman, and H. M. Baker.
Analytical Chemistry, Vol 52, No 12, p 1983-1984, October, 1980. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Asbestos, *Electron microscopy, *Pollutant identification, Analytical techniques, Industrial effluents, Spectroscopy, Crystallography.

The analysis of asbestos in waste water effluents, especially of high solids and low chrysotile contents, by transmission electron microscopy presents some inconveniences. The selected area electron diffraction patterns (SAED) on which current asbestos analyses are based pose several problems. One major problem lies in the lack of a consistent classification scheme. Many patterns are initially incomplete, and others will fade within 30 sec to such an extent as to be unidentifiable. This is caused by electron beam induced degradation due to dehydroxylation and carbon contamination. This problem, coupled with differences in instruments, and the presence of fiber coatings or interfering crystalline solids, makes SAED identification unreliable. Subjecting individual fibers to elemental analysis with an energy dispersive spectrometer (EDS) can improve the situation. The use of the microdiffraction mode rather than SAED can aid identification in the diffraction portion of the method. Such analysis provides stable patterns which do not fade in the time required for anlysis of chrysotile asbestos in water and air samples. The EPA interim method with SAED replaced by microdiffraction could be used to test relatively clean water samples such as those from lakes or from tap water. (Baker-FRC)
W81-00901

ACTIVATED SLUDGE CONTROL IN THE SECONDARY SETTLING BASIN USING THE SLUDGE SETTLING ANALYZER,
Kanazawa Univ. (Japan). Dept. of Construction and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W81-00912

SOME PROBLEMS IN THE DETERMINATION OF TOTAL RESIDUAL 'CHLORINE' IN CHLORINATED SEA-WATER,
Old Dominion Univ., Norfolk, VA. Inst. of Oceanography.
G. T. F. Wong.
Water Research, Vol 14, No 1, p 51-60, 1980. 6 Fig, 28 Ref.

Descriptors: *Volumetric analysis, *Chlorine, *Sea water, Chlorination, Analytical techniques, Chemical analysis, Effluents, Halogens, Bromine.

Significant errors may occur in using the amperometric titrimetric method to determine the amount of residual chlorine in chlorinated sea water unless specific precautions are taken. If the pH 4 buffer is added to the sample before the potassium iodide solution is added, serious analytical errors will result. Even if the reagents are added only seconds apart, the error will be significant, probably due to the volatilization of molecular bromine. In freshwater samples this practice should also be avoided, as loss of molecular chlorine may result. Even when the potassium iodide is added first, care must be taken to add the acidic buffer not more than 1 minute afterwards. Iodate present in sea water may cause significant uncertainty in determining small quantities of residual chlorine. Clear definitions in the literature for reporting the concentrations of residual chlorine are necessary. The preferred unit is micromolar concentration of hypohalite. (Baker-FRC)
W81-00917

ROLE OF STRONG ION EXCHANGE RESINS IN NITROSAMINE FORMATION IN WATER,
Science and Education Administration, Philadelphia, PA. Eastern Regional Research Center.
W. I. Kimoto, C. J. Dooley, J. Carre, and W. Fiddler.
Water Research, Vol 14, No 7, p 869-876, July, 1980. 9 Tab, 14 Ref.

Descriptors: *Ion exchange, *Resins, *Organic compounds, Potable water, Cations, Anions, Water analysis, Nitrogen compounds, Nitrosamines, Water pollution sources, Toxins, Ammonia.

The passing of tap water through a column containing only anion exchange resin caused formation of N-nitrosodimethylamine (NDMA). This indicated that nitrosamine formation by conventional acid catalyzed nitrosation was not the primary mechanism in NDMA formation. It is suggested that the quaternary ammonium ion of the strong anion resin may be the amine precursor for nitrosamine formation. Low levels of NDMA added to the influent were not able to be concentrated by strong anion and strong cation resins such as Amberlite and Dowex brands. Thus it was concluded that low levels of nitrosamine already present in the water do not contribute significantly to the concentration of nitrosamines found in deionized water. Normal levels of cations, anions, and heavy metals were similarly not responsible for the nitrosamines present in the water after passing through the column. An unknown substance was isolated in tapwater that promoted nitrosamine formation. This substance was able to be removed from the water either by activated carbon treatment or by degassing techniques. (Baker-FRC)
W81-00922

DETERMINATION OF NITRITE ION IN WASTE AND TREATED WATERS BY RESONANCE RAMAN SPECTROMETRY,
Meidensha Electric, Tokyo (Japan). Water Treatment Engineering Div.
N. Furuya, A. Matsuyuki, S. Higuchi, and S. Tanaka.
Water Research, Vol 14, No 7, p 747-752, July, 1980. 7 Fig, 4 Ref.

Descriptors: *Analytical techniques, *Pollutant identification, *Spectrometers, *Nitrites, Nitrates, Chemical analysis, Dyes, Waste water treatment, Water analysis, Resonance.

Resonance Raman spectrometry has been used to determine the concentration of nitrite ions in waste water. As the Raman spectrometry technique requires a colored product for identification, the nitrite is converted to an azo dye product by chemical reaction. The addition of sodium thiocyanate during the procedure reduced the background interference to such a degree that the sensitivity of this method is rated at about 0.5 ppb, which is approximately one order of magnitude lower than the sensitivity of the colorimetric method usually employed for such determinations. The analytical curve obtained for the aqueous solutions of nitrite ion in the concentration range from 10 to 180 ppb fit well enough to a straight line in the concentration range below 140 ppb. The standard deviation for the straight line is very small, 2.70 ppb. Thus the sensitivity of this method is high enough for optimum control of waste water treatment and the technique is practical for waste and treated water samples. The simultaneous determination of nitrite ion and nitrate ion utilizing this process was proposed. (Baker-FRC)
W81-00927

A MODEL PROVISION FOR NON-DEGRADATION OF GROUNDWATER: WHAT IS A DETRIMENTAL EFFECT AND WHERE IS IT MEASURED,
Wisconsin Univ.-Oshkosh. Coll. of Letters and Science.
J. I. Hoffman.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 168-173, 1980. 3 Ref. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Wisconsin, *Aquifer testing, *Waste water(pollution), *Water quality control, *Waste disposal, Degradation, Monitoring, Geochemistry, Attenuation, Reservoirs, Pollution, EPA, Contamination, Subsurface drainage, Water quality standards, Path of pollutants, Model studies, Groundwater.

Non-degradation and zero pollution of water are goal statements which in practice cannot be achieved. Therefore, some measurable parameters must be set so that activities necessary for the existence of society can be evaluated as to compliance with a reasonable standard. A model framework for groundwater protection is presented. The goal should be that no activity will cause a statistically significant deviation from the main geochemistry of the groundwater existing beneath or in potential contact with a proposed activity. For waste disposal facilities, a compliance point is defined as the lesser of 1,200 feet from the source or the project property line, and an intervention point is established at one-half of the above distance. The intervention point is the place where measurements against the standards are to be taken, and correction action employed if necessary. For hazardous wastes, or large activities which involve a site of more than 100 acres, a computer model of groundflow and contamination should be required. (Garrison-Omniplan)
W81-00935

DETERMINATION OF TRIHALOMETHANES (THM) IN WATER USING HIGH EFFICIENCY SOLVENT EXTRACTION,
National Swedish Environment Protection Board, Stockholm (Sweden). Dept. of Environmental Hygiene.
H. Norin, and L. Renberg.
Water Research, Vol 14, No 10, p 1397-1402, October, 1980. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Gas chromatography, *Organic compounds, *Potable water, *Solvent extractions, *Separation techniques, Analytical techniques, Disinfection, Organic wastes, Monitoring, Rivers, Water pollution, Industrial wastes, Pulp wastes, Trihalomethanes.

A method for the gas chromatographic determination of trihalomethanes (THM) in water using solvent extraction is described. Volatile halogenated hydrocarbons occur in drinking water, natural water and waste waters as a result of industrial pollution or disinfection processes. In the present technique, the organic phase was extracted into a mixture of hexane and diisopropyl ether and was analyzed by gas chromatography. Mean recoveries of THM ranged from 89.0 to 106.0% in spiked samples when a solvent:water ratio of 1:50 was used. Ascorbic acid was recommended for preservation of water samples until analysis time, rather than sodium thiosulfate. The technique has been applied to the monitoring of THM levels in Swedish drinking water and the estimation of THM occurrence in pulp and paper mill effluents. Problems of emulsion formation in the latter studies due to high organic content were overcome by centrifugation. Of the 107 drinking water samples studied, 90% had THM levels in the range of 0.2-25 micrograms/liter. (Geiger-FRC)
W81-00936

A CONVENIENT PARAMETER FOR TRACING LEACHATE FROM SANITARY LANDFILLS,
Wollongong Univ. (Australia). Dept. of Chemistry.
J. Ellis.
Water Research, Vol 14, No 9, p 1283-1287, September, 1980. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Potassium, *Tracers, *Municipal wastes, *Path of pollutants, *Leaching, Groundwater movement, *Waste dilution, Landfills, Biochemical oxygen demand, Waste disposal, Leachate, Ion transport, Groundwater, Water pollution, Microbial degradation, Chemical degradation, Clays, Discharge.

Large amounts of material of vegetable origin have been identified in typical samples of municipal

wastes. Such constituents are subject to microbial and chemical breakdown producing high biochemical oxygen demands. As a result elevated levels of potassium often occur in the leachate and may serve as an accurate and easily measurable tracer for wastes. Studies of potassium ion levels in water samples collected at monthly intervals from three sampling sites at Russell Vale show this parameter served as a clean indicator of leachate pollution of groundwater. Potassium ion measurements also revealed the direction of movement of the leachate as illustrated in correlations of potassium ion concentrations in waters downstream from a landfill to levels upstream. Potassium ions could not be used to monitor leachate contributions when the inherent water level of this ion was high, when extended passage of leachate through potassium-absorbing clay strata was expected, or when leachate was derived from landfills receiving mainly industrial wastes. Although the cover material was shown previously not to be a source of potassium ion enrichment, care should be taken not to measure possible potassium ion contribution from contact with agricultural fertilizers, concrete and other odd cation sources. (Geiger-FRC)
W81-00942

EVALUATION OF A PORTABLE BARE-ELECTRODE AMPEROMETRIC ANALYZER FOR DETERMINING FREE CHLORINE IN POTABLE AND SWIMMING-POOL WATERS,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
E. Canelli.
Water Research, Vol 14, No 10, p 1533-1540, October, 1980. 1 Fig, 8 Tab, 17 Ref.

Descriptors: *Potable water, *Swimming pools, *Amperometry, *Analytical techniques, *Chlorine, Titration, On-site tests, Sampling, Laboratory tests, Water analysis, Water pollution.

The determination of chlorine as HOCl or ClO(-) was carried out by a bare-electrode portable amperometric analyzer in samples of potable and swimming pool water. The method used no titration and gave rapid and precise results for chlorine levels ranging from 0.10 to 3.0 ppm chlorine. Stoichiometrically equivalent signals were noted for hypochlorite and bromine, triiodide ion, and Mn(VII), but no detectable amperometric signals were observed from MnO2. Interference was observed from N-chloroglycine, NH2Cl, NHCl2 and NCl3. Monochloroisocyanurate, chlorinated bovine albumin, and chlorinated urea gave amperometric signals which were lower than those produced by the N,N-diethyl-p-phenylenediamine (DPD) procedure. When potable water samples were analyzed for free chlorine using the DPD and amperometric method, no significant differences were found between the two sets of results. Field and laboratory tests on swimming pool water samples using both techniques resulted in slightly higher free chlorine values when the DPD method was used. This discrepancy was attributed to the presence of chlorinated urea in the samples, which gives a lower signal in amperometric analyses. (Geiger-FRC)
W81-00945

APPLICATION OF TWO ATTENUATION MECHANISM THEORIES TO A SANITARY LANDFILL,
Wisconsin Dept. of Natural Resources, Madison, Bureau of Solid Waste Management.
A. Bagchi, R. L. Dodge, and G. R. Mitchell.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 201-213, 1980. 8 Fig, 1 Tab, 26 Ref. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Wisconsin, *Attenuation, *Cations, *Leachate, Monitoring, Groundwater, *Landfills, Subsoils, Surface water, Dispersion, Chlorine, Iron, Dilution, Madison area(WI).

Monitoring accuracy for testing cation exchange and dilution as attenuation mechanisms for landfill leachate is examined. Observations at points beneath and downgradient from the Dane County, Wisconsin landfill revealed a change in pH from alkaline toward a neutral value. It is difficult to draw any conclusions regarding the change, since background water quality monitoring data showed a large fluctuation of groundwater hardness through time. Calculations indicated it would take about 200 days for any contaminant to reach the nearest downgradient well. So far, a significant increase in the concentration of the parameters studied has not been observed. Further observation is needed to ensure that monitoring techniques used in the study were adequate to detect the contaminants if they are present. Recommendations for future study include additional downgradient monitoring points at depths calculated using the dispersion theory, and monitoring of upgradient water quality in the same aquifer monitored by the downgradient wells. A program is recommended for periodic leachate analysis to determine the leachate quality through time. (Garrison-Omniplan)
W81-00959

DETAILED REPORT ON THE USE OF ENZYMATIC CYCLING FOR HIGH SPECIFICITY AND PRECISION IN THE COLORIMETRIC ANALYSIS OF AMMONIA,
American Univ., Washington, DC. Dept. of Chemistry.
F. W. Carson, and H. W. Davies.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-145070, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia, Washington, Report No 21, October, 1980. 80 p, 13 Fig, 11 Tab, 47 Ref. OWRT-B-011-DC(1).

Descriptors: *Ammonia, *Nitrogen compounds, *Analytical techniques, *Colorimetry, *Water analysis, *Methodology, Waste water(Pollution), Ammonium compounds, Ammonium salts, Analysis, Assay, Color reactions, Laboratory tests, Research and development, Testing, Testing procedures, Measurement, Calibrations, Evaluation, Estimating, Monitoring, Statistics, Technology, Waste identification.

A new method was developed for the determination of ammonium ion concentrations in water in the range of 0.0001-0.00001 molar, based upon enzymatic cycling. The sensitivity of the method could be extended well below the ten nanomoles/sample limit of determination, using suitable modifications of the procedure. This two-step method involved the use of an ammonia-specific glutamate dehydrogenase enzyme reaction with simultaneous oxidation of NADH; followed by an enzymatic cycling reaction to measure oxidized NADH by means of measuring the cycling reaction product, a tetrazolium formazan, in the visible at 600 nm. Using the procedure, linear plots of absorbance versus original ammonium ion concentration had correlation coefficients of 0.997-0.9998. The precision (coefficient of variation) of the method on replicate analyses of samples containing 0.0000441 molar ammonium ion was 2%. A calibration curve for determination of unknown ammonium concentrations could be constructed from standard solutions carried through the procedure. Analysis time per sample was three hours, and all solutions were stable for at least two weeks. (Zielinski-IPA)
W81-00987

5B. Sources Of Pollution

NITRATE FLUCTUATIONS IN GROUND WATER AS INFLUENCED BY USE OF FERTILIZER,
Connecticut Agricultural Experiment Station, New Haven.
H. C. DeRoo.
Bulletin 779, June, 1980. 13 p, 6 Fig, 8 Tab, 26 Ref.

Descriptors: *Nitrates, *Connecticut, *Groundwater, *Fertilizers, *Leachate, Tobacco, Nitrogen, Pollution, Organic compounds, Percolation, Soil types, Irrigation.

Fertilizers are often cited as sources of nitrogen in ground and surface water in suburban and rural areas. The most important nitrogen compounds found in soil solutions are ammonium and nitrate nitrogen (NO3-N). Nitrate nitrogen can be leached by heavy rain and eventually appear in ground and surface water. It is a component of the fertilizers studied on two types of terrain---farmland and suburban turf---to determine if they contribute to nitrate pollution of groundwater in the Connecticut River Valley. Groundwater under the Valley Laboratory Farm averaged 3mgL-1 nitrate nitrogen over three years, with temporary concentrations exceeding 10mgL-1 after a heavy rainfall, as observed downstream from areas treated with generous amounts of fertilizer. on the Merrell Farm in Suffield, a rural environment, there were yearround high levels of nitrate nitrogen, averaging 20mgL-1. The groundwater under suburban turf plots was not significantly influenced by moderate fertilization treatments, suggesting that the potential for nitrate leaching under turf is not significant if a reasonable N fertilizer program on lawns is followed. (Garrison-Omniplan)
W81-00754

TRANSPORT OF POTENTIAL POLLUTANTS IN RUNOFF WATER FROM LAND AREAS RECEIVING ANIMAL WASTES: A REVIEW,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. Khaleel, K. R. Reddy, and M. R. Overcash.
Water Research, Vol 14, No 5, p 421-436, May, 1980. 6 Tab, 54 Ref.

Descriptors: *Water pollution sources, *Farm wastes, *Nutrients, *Agricultural runoff, Snowmelt, Feed lots, Pastures, Ranges, Rainfall-runoff relationships, Chemical oxygen demand, Pathogenic bacteria, Path of pollutants, Ultimate disposal.

Literature on the quality of agricultural discharges from lands receiving animal wastes, the effects of climate, rates and timing of manure applications, and management practices relative to the transport of nitrogen and phosphorus nutrients, oxygen demanding compounds, and pathogens is reviewed. Pastures and rangelands where animals deposit wastes directly, croplands and other lands receiving mechanically spread animal wastes, and feedlots are considered. For lands receiving manure applications, linear regression analysis showed a highly significant correlation between nitrogen or phosphorus nutrient loading rates and both its average concentration in runoff water and its mass yield. Nutrient and COD losses were considerably higher when manure was applied on land subject to snowmelt runoff or within one day of significant rainfall. Thus higher concentrations and mass yields result from applications in spring and winter than in summer and fall. Applications of manure in solid form and as incorporated in soil result in low nutrient loss, but liquid injected application essentially eliminates pollutants in runoff. Pathogenic organisms are retained mostly at or near the soil surface, which creates great potential for surface runoff water pollution. Nutrient losses from pastures and rangelands are rarely significant and may be controlled with proper grazing schedules and by controlling erosion, sediment transport, and surface runoff. Pollutant concentrations are higher in feedlots by several orders of magnitude, with snowmelt runoff a principal factor. Future research should be directed to relating data on small plot-sized areas to larger watersheds and edge-of-field losses to receiving waters. (Just-FRC)
W81-00775

THE EFFECT OF PHYSICOCHEMICAL, PHYTOPLANKTON AND SEASONAL FACTORS ON FAECAL INDICATOR BACTERIA IN NORTHERN BRACKISH WATER,
Elainlaaketieteellinen Korkeakoulu, Helsinki (Finland).
J. Hirn, H. Vijamaa, and M. Raevuori.
Water Research, Vol 14, No 3, p 279-285, March, 1980. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Bioindicators, *Water quality, *Aquatic bacteria, *Fluctuations, *Gulfs, *Nutrients, Hydrogen ion concentration, Phytoplankton,

Sampling, Coliform bacteria, Seasonal, Brackish water, Laboratory tests, Streptococcus, Clostridium, Eutrophication, Statistical analysis, Temperature, Nitrogen, Salinity, Nitrates, Nitrites, Salmonella, Phosphorus, Finland.

Seasonal, physicochemical, and phytoplankton parameters were examined in relation to the number of coliforms, fecal coliforms, fecal streptococci, and Clostridium perfringens at several stations in the brackish waters of the Gulf of Finland. The study period lasted for 1 year, over which seasonal changes in the fecal indicator bacteria were noted. A significant correlation was found among the various species of non spore-forming fecal indicator bacteria investigated. Temperature and pH were found to have a marked effect on the number of fecal indicator bacteria. Some nutrients, especially total nitrogen and nitrate nitrogen, also played a role in influencing the number of fecal indicator bacteria present. The lack of correlation between C. perfringens and the other indicator bacteria was attributed to changes in pH values. It was concluded that C. perfringens would be useful as an indicator organism in ecosystems containing many stress factors. Since stress factors may affect the number of fecal indicator bacteria present, it was advised that the quality of water be evaluated using several parameters. (Geiger-FRC)
W81-00792

OCCURRENCE OF SULPHATE REDUCING BACTERIA IN THE HUMAN INTESTINAL FLORA AND IN THE AQUATIC ENVIRONMENT,
Institut Pasteur, Paris (France). Domine du Certia.
H. Leclerc, C. Oger, H. Beerens, and D. A. A. Mossel.
Water Research, Vol 14, No 3, p 253-256, March, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Enteric bacteria, *Water pollution, *Sewage treatment, *Sulfur bacteria, *Bioindicators, E. coli, River waters, Potable water, Secondary treatment, Sewage sludge, Sewage bacteria, Activated sludge, Cultures, Sampling, Laboratory tests, Chlorination, Monitoring.

A total of 609 samples of water, sludge, and human stools was examined for the presence of sufate-reducing bacteria. A random choice of 325 of these samples was studied for the presence of E. coli. Of the water samples, 220 were from tap water, 45 from rivers, 61 from influents, 30 from primary sewage effluent, 65 from secondary sewage effluent, and 45 from activated sludge. Sulfate reducing bacteria were detected at a mean rate of 1,000,000/100 g of feces, 1,000,000/100 ml of crude sewage, 100,000/100 ml of river water and about 100/100 ml of tap water. Some similarities were found in distribution curves of sulfate-reducing bacteria and E. coli in some types of water. The occurrence of sulfate-reducing bacteria at high levels in various types of water suggests their fecal origin. However, the high resistance of sulfate reducing bacteria to extraenteric conditions and the complicated techniques required for their detection make them inappropriate as indicator organisms for routine environmental pollution monitoring. (Geiger-FRC)
W81-00793

STREAM-WATERSHED RELATIONSHIPS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Univ.-Columbia.
For primary bibliographic entry see Field 4C.
W81-00803

DEVELOPMENT OF MODELS TO PREDICT QUALITY OF RUNOFF WATER FROM AGRICULTURAL WATERSHEDS,
Tennessee Univ., Knoxville.
C. H. Shelton, and G. M. Lessman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143380, Price codes: A03 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, University of Tennessee, Research Report No 77, September, 1980. 35 p, 6 Fig, 11 Tab, 11 Ref. OWRT A-047-TENN(1).

Descriptors: *Model studies, *Agricultural runoff, Forecasting, *Water quality, *Sediment yield, Nutrients, Metals, Sewage sludge, Agricultural practices, Runoff, Coliforms, Groundwater, Aricultural watersheds.

Municipal sewage sludge following primary sedimentation was applied on a 3.7-ha watershed during four winter months of 1976, 1977, and 1978 at rates of 20.8, 25.7 and 25.2 t/ha (dry weight), respectively. Samples of the sludge, surface runoff, groundwater, soil, and corn leaves were analyzed for selected nutrients and metals. Concentrations of metals and nutrients in runoff were generally low and constant throughout the sampling period. Infrequent high concentrations of nutrients and metals, as well as fecal coliform count, were attributed to runoff occurring soon after applications of sludge when little or no vegetation was present. Concentrations of metals in groundwater sampled in the third year of sludge applications generally showed no increase over those in surface runoff. Data used for generation and testing of regression equations to predict sediment yield were obtained from a total of 145 runoff events on four small (3.7-80.4 ha) agricultural watersheds during the period 1974-1979. Attempts were made to modify the universal soil loss equation by inserting various combinations of watershed and climatic variables to describe conveyance and antecedent conditions. A stepwise linear regression of variables after logarithmic transformation accounted for more variation in sediment yield on two watersheds than other forms of equations attempted. Due to major differences in land use, however, a separate sediment-yield prediction equation was required for each of the four watersheds.
W81-00805

ANALYSES OF WATER AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1976-78,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W81-00836

CATCHMENT QUALITY CONTROL,
Thames Water Authority, London (England). Directorate of Scientific Services.
For primary bibliographic entry see Field 5G.
W81-00854

TOXIC SUBSTANCES FROM FRESHWATER ALGAE,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W81-00855

WELL WATER QUALITY ON MOEN ISLAND, TRUK,
Guam Univ., Agana. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W81-00866

MICROBIOLOGICAL EVALUATION OF COASTAL WATERS QUALITY IN THE TYRRHENIAN SEA,
Genoa Univ. (Italy). Inst. of Hygiene.
F. L. Petrilli, G. P. De Renzi, P. Orlando, and S. De Flora.
Progress in Water Technology, Vol 12, No 1, p 129-136, 1980. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Sea water, *E. coli, *Streptococcus, *Viruses, *Coliforms, *Sewage bacteria, Tyrrhenian Sea, Microbiology, Water quality, Beaches, Coasts, Public health, Europe.

The microbiological quality of coastal waters in the Tyrrhenian Sea was evaluated in a four year study. Animal viruses were concentrated from sea water samples and sediments by adsorption of insoluble polyelectrolytes. Total coliforms were detected using the multiple tube fermentation test. Fecal streptococci were detected using the membrane filter method. Isolated viruses included types 1, 2, and 3 poliovirus, echovirus, one strain of reovirus, and unidentified enteroviruses. The virus titer ranged from 0.6 to 16 TCD50 per 100 ml of surface sea water, from 0.2 to 1.2 for bottom water, and from 4 to 40 for sediment eluates. The bacteriological load of the pollution in the area was highly variable. Most bathing areas were below 100 E. coli in 100 ml sea water, a limit set by Italian sanitary authorities. A positive correlation was found between total coliforms and E. coli, between total coliforms and fecal streptococci, and between E. coli and fecal streptococci. A significant positive correlation was also found between the numbers of E. coli and enteroviruses. The terminal tracts of two rivers, the Calambrone and the Cecina, were included in the coastline studied. The Cecina river, which receives a number of sewage effluents, was highly polluted, while the pollution load introduced by the Calambrone river was relatively low. (Small-FRC)
W81-00887

SANITARY AND AESTHETIC QUALITY OF THE COASTAL WATERS OF SPAIN,
Ministry of Public Health and Social Security, Madrid (Spain).
R. Mujeriego, and B. Sanchez Murias.
Progress in Water Technology, Vol 12, No 1, p 119-127, 1980. 6 Tab, 6 Ref.

Descriptors: *Sea water, *Coliforms, *Sewage bacteria, *Epidemiology, *Morbidity, Water quality, Beaches, Europe, Public Health, Mathematical studies, Spain.

The degree of pollution at the beaches and coastal areas of Spain was evaluated during the summers of 1977 and 1978. Microbiological water quality was recorded at selected beaches, and standardized epidemiological studies were carried out among people using the beaches. The multiple dilution technque was used to determine total coliform and fecal coliform concentrations in sea water. Approximately 15 to 30% of the areas studied could not be considered microbiologically satisfactory according to national and international water quality standards. The eidemiological study utilized 16,693 valid questionaires from 10 coastal provinces. No statistically significant correlation was found between morbidity rates for skin eruptions, or eye, ear, and nose infections and local sea water quality expressed in terms of total coliforms. There was a significant correlation between morbidity rates for mycosis and total coliform concentrations. (Small-FRC)
W81-00888

PRELIMINARY ESTIMATE OF MERCURY POLLUTION IN THE FRENCH MEDITERRANEAN (PROVENCE-COTE D'AZUR) BY STUDYING CONTAMINATION LEVELS IN SEDIMENTS AND BENTHIC ORGANISMS (PREMIERE ESTIMATION DE LA POLLUTION MERCURIELLE DU LITTORAL MEDITERRANEEN FRANCAIS (PROVENCE-COTE D'AZUR) PAR L'ETUDE DU DEGRE DE CONTAMINATION DES SEDIMENTS ET DES ORGANISMS BENTHIQUES),
Centre Universitaire de Luminy, Marseille (France).
For primary bibliographic entry see Field 5A.
W81-00890

DISTRIBUTION OF HEAVY METALS IN THE SUPERFICIAL MARINE SEDIMENTS IN THE VICINITY OF THE RHONE MOUTHS,
Nice Univ. (France). Lab. de Sedimentolgie.
A. Added, F. Fernex, and F. Rapin.
Progress in Water Technology, Vol 12, No 1, p 89-96, 1980. 8 Fig, 11 Ref.

Descriptors: *Sea water, *Sediments, *Rivers, *Heavy metals, Water pollution, Mercury, Lead, Cobalt, Nickel, Zinc, Cadmium, Spectrophotometry, Copper, France, Rhone River, Transport, *Path of pollutants.

The transport of heavy metals to the sea by the Rhone River was investigated by analysis of sur-

face marine sediments within 20-30 km of the mouth of the river. The sediment samples were passed through a 63 micron sieve, and atomic absorption spectrophotometry was performed, followed by extraction in concentrated nitric-perchloric acid. The highest concentrations of metals were found near the river's mouth, with the exception of mercury, which was also high in the Golfe of Fos region. Concentrations in mg/kg were: 31-145 for Pb, 1-14 for Co, 13-32 for Ni, 70-160 for Zn, 18-50 for Cu, 0.14-1.5 for Cd, and 0.08-1.93 for Hg. This first phase of the analysis of results includes concentration contour maps. (Small-FRC)
W81-00893

PROBLEMS OF STORAGE OF VARIOUS SUBSTANCES FOUND IN THE INTERSTITIAL WATERS OF THE SURFACE SEDIMENTS OF THE FRENCH CONTINENTAL SHELF,
Station Marine, Villefranche-sur-Mer (France). Laboratoire Geodynamique Sous-marine.
C. Bagliniere, J. Cenciarini, F. Fernex, R. Pucci, and R. Vaissiere.
Progress in Water Technology, Vol 12, No 1, p 79-87, 1980. 7 Fig, 17 Ref.

Descriptors: *Sediments, *Sea water, *Nutrients, *Surfactants, Detergents, Ammonium compounds, Ions, Water pollution, Europe, Mediterranean, Cote d'Azur, Continental shelf, France.

The concentrations of a number of substances or ions existing in dissolved form in interstitial waters of superficial sediments of the continental shelf of the Cote d'Azur were determined. These substances include nutrients and anionic surfactants. Conentrations varied with region and time of year. For example, in November 1978, following a long period of good weather, the ammonium concentrations were very high in the superficial sediments of the Bay of Nice, reaching 1000 micrograms/liter. In January, the concentrations decreased as much as 100 times. There were no clear correlations between the various parameters studied. Thus, there were opportunities for dissolved nutrients, detergents, etc. stored in the interstitial waters to be liberated into the sea water, but the reasons for variations in rate of liberation are not yet known. The concentrations of anionic surfactants found in the Nice region were surprisingly low; this may be due to efficient waste water purification by this municipal system or to rapid biodegradation. (Small-FRC)
W81-00894

DISPERSANTS FOR ELIMINATING OIL SPILLS (AGENTES DISPERSANTES PARA ELIMINAR DERRAMES DE PETROLEO),
Carretera de Valldemosa, Palma de Mallorca (Spain). Dept. of Chemical Engineering.
M. Estrades, and J. R. Bergueiro.
Progress in Water Technology, Vol 12, No 1, p 35-48, 1980. 4 Tab, 6 Ref.

Descriptors: *Dispersion, *Sea water, *Oil, *Oil pollution, Water pollution, treatment, Oil spills, Salinity, Laboratory tests, Mixing, Surfactants, Non-ionic dispersants.

Experiments revealed that the dispersion of crude oil in sea water is influenced more by the velocity of agitation than by the dispersant/crude oil ratio. A non-ionic dispersant, Renex 690, and a Kiruk-type crude oil were used in sea water with a saline level greater than 5 g/liter. Changes in the concentration of crude oil in the sea water relative to the duration and velocity of agitation were determined. Optimum dispersion was obtained by stirring at 4000 rev/min. The optimum dispersant/oil ratio was 0.35 g. Regression analysis with 90% confidence limit indicated a 3% deviation from the mean with 15% dispersion. (Small-FRC)
W81-00896

BASELINE LEVELS OF HEAVY METALS IN THE WATERS AND SEDIMENTS OF BAFFIN BAY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
J. A. Campbell, and D. H. Loring.
Marine Pollution Bulletin, Vol 11, No 9, p 257-261, September, 1980. 1 Fig, 3 Tab, 22 Ref.

Descriptors: *Heavy metals, *Sea water, *Sediments, *Bays, Spectrophotometry, Iron, Manganese, Baffin Bay, Greenland, Cadmium, Chromium, Cobalt, Copper, Zinc, Mercury, Nickel, Baseline studies.

Baseline trace metal studies of both the waters and sediments of Baffin Bay, Greenland, were performed. Samples from the principal water fluxes and deep bay water were analyzed by flameless atomic absorption spectrometry following chelation (solvent extraction or ion exchange techniques). Sediment samples were obtained at water depths from 93 to 2320 m and sedimentological and chemical analyses were carried out. Concentrations of Cr, Mn, Fe, Ni, Cu, and Cd in water samples were generally lower than those observed in eastern Canadian coastal waters. Levels were close to those found in open ocean samples. Near shore sediment samples had comparable concentrations of Cr, V, Mn, Ni, Co, Cu, Zn, Hg, and Pb to unpolluted muds in eastern Canadian coastal regions. Concentrations of these elements in deep water sediments closely resembled levels in Atlantic Ocean deep-sea clays. (Small-FRC)
W81-00905

METHYLATION OF LEAD IN MARINE SEDIMENTS,
Institute of Ocean Sciences, Sidney (British Columbia). Ocean Chemistry Div.
J. A. J. Thompson, and J. A. Crerar.
Marine Pollution Bulletin, Vol 11, No 9, p 251-253, September, 1980.

Descriptors: *Sediments, *Lead, Mine wastes, Fjords, Coasts, Methane bacteria, Water pollution sources, Canada, British Columbia, Methylation, Aquatic microbiology.

Sediments were collected from a northern British Columbia fjord, Alice Arm, and three other coastal locations, to study the possible release of lead from mine tailings deposited in Alice Arm. The comparative abilities of the four sediments to support biologically mediated methylation of lead added in three chemical forms were determined. Lead as Pb(OAc)2 was not methylated under the experimental condition used. About 0.03% of lead as Pb(NO3)2 underwent methylation. Tetravalent lead, as (CH3)3PbOAc, was methylated almost completely. However, it is unlikely that (CH3)3PbOAc would be present under natural conditions. The sediments from the four locations showed little variation in methylating capacity, and there was no relationship between methylating capacity and the total ambient lead concentration. The lead contained in the mine tailings was not mobilized in detectable amounts. Thus, the lead in the samples was mostly unavailable to biological processes. (Small-FRC)
W81-00906

LABORATORY STUDIES ON THE ADSORPTION OF ACRYLAMIDE MONOMER BY SLUDGE, SEDIMENTS, CLAYS, PEAT AND SYNTHETIC RESINS,
Plymouth Polytechnic (England). John Graymore Chemical Labs.
L. Brown, K. C. C. Bancroft, and M. M. Rhead.
Water Research, Vol 14, No 7, p 779-781, July, 1980. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Adsorption, *Resins, Clays, Sediments, Sludge, Peat, Plastics, Waste water treatment, Toxins, Hydrogen ion concentration, Rivers, Chemical degradation, Acrylamide, Organic compounds.

The polyacrylamides are often contaminated by the highly toxic acrylamide monomer during their manufacture. Polymers are used extensively in water treatment processes; standards limit the level of acrylamide in potable water to 0.25 micrograms/liter. Long term analysis of the adsorption of acrylamide by sludges under environmental conditions has been hindered by the rapid degradation of the acrylamide monomer in non-sterile environments. The removal of acrylamide monomer from the water column by adsorption onto sludge, peat, and sediment particles was examined in short-term experiments. No significant adsorption of acrylamide monomer was found. Other studies showed that no acrylamide was rmoved from sterilized river water by clays and anionic, cationic or hydrophobic resins at various concentrations and pH levels tested. A limited affinity for acrylamide was found in activated carbon, which was not affected by pH in the range investigated. (Geiger-FRC)
W81-00924

MODEL STUDIES OF THE DEGRADATION OF ACRYLAMIDE MONOMER.
Plymouth Polytechnic (England). John Graymore Chemical Labs.
L. Brown, M. M. Rhead, K. C. C. Bancroft, and N. Allen.
Water Research, Vol 14, No 7, p 775-778, July, 1980. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Organic compounds, *Microbial degradation, *Model studies, *Plastics, Biodegradation, Anaerobic bacteria, Aerobic bacteria, Photosynthetic bacteria, Waste water disposal, Sampling, Acrylamides.

Factors which are likley to affect the residence time of acrylamide in natural and polluted waters are discussed. Acrylamide degraded in all unsterilized natural and polluted water samples studied. The major cause of acrylamide loss from spiked water samples was microbial degradation. The ability to degrade the chemical is widespread among natural bacterial stocks found in river, estuarine and sea water samples. In situations where light is available the major decomposers will be photosynthetic, while nonphotosynthetic bacteria predominate in darker regions. Light did not significantly alter the degradation of acrylamide; however, degradation did occur more rapidly in light than in dark after deaeration. This suggests that certain nonphotosynthetic aerobic and photosynthetic and nonphotosynthetic anaerobic bacteria in the samples tested had the capability to degrade acrylamide. Sterile samples of tap water taken at Plymouth showed no chemical degradation occurring over 2000 hr. It is suggested that the industrial addition of strong acids, bases, oxidizing or reducing agents to process waste waters may aid in degrading acrylamide. (Baker-FRC)
W81-00925

VIRUS INTERACTIONS WITH SOIL COMPONENTS: MEASUREMENTS AND USE FOR PREDICTING MOVEMENT DURING LAND APPLICATION OF MUNICIPAL WASTEWATER,
California Univ., Los Angeles. Dept. of Chemical, Nuclear and Thermal Engineering.
V. L. Vilker.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 34-53, 1980. 12 Fig, 22 Ref. University of Wisconsin - Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Viruses, *Waste water disposal, *Sands, *Clays, *Adsorption, Sorption, Percolation, Sewage, Effluent, Attenuation, Filtration, Soils, Electron microscopy, Entrapment.

Growing interest in various forms of water reuse, and an increased awareness concerning public health aspects of wastewater disposal, require better understanding of the fate of human pathogens contained in domestic raw sewage. Studies on the fate of viruses in soil-water environments and recent research on the specific interactions of attenuated poliovirus I with sand and clay are summarized. The results concerning sand indicate that adsorption sites occupy about 1.5% of the total sand particle surface area. There is also indication that the adsorption reaction of polio to sand is weak. The clay interaction was examined both optically and with electron microscopy which gave reasonable assurance that poliovirus is removed from clay suspensions of batch equilibrium experiments by the adsorption mechanism. The

poliovirus preparations and the batch adsorption mechanism suspensions were of the same composition in both the sand and clay studies. Further study of the movement of poliovirus through laboratory packed beds of sand and sand/clay mixtures, to assure that clay aggregation effects are absent or minimized, would be desirable. (Garrison-Omniplan)
W81-00930

A MODEL PROVISION FOR NON-DEGRADATION OF GROUNDWATER: WHAT IS A DETRIMENTAL EFFECT AND WHERE IS IT MEASURED,
Wisconsin Univ.-Oshkosh. Coll. of Letters and Science.
For primary bibliographic entry see Field 5A.
W81-00935

OZONE-INDUCED BIODEGRADABILITY OF A NON-IONIC SURFACTANT,
Environmental and Water Resources Engineering, Haifa (Israel).
N. Narkis, and M. Schneider-Rotel.
Water Research, Vol 14, No 9, p 1225-1232, September, 1980. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Ozone, *Surfactants, *Waste water treatment, *Chemical oxygen demand, *Biodegradation, Ultraviolet radiation, Organic wastes, Sewage effluents, Biological treatment, Molecular structure, Waste treatment, Separation techniques.

The OECD (Organization for Economic Cooperation and Development) screening test for biodegradability was modified to test the ozone-induced biodegradability of a non-ionic surfactant, branched chain nonyl phenol ethoxylate. Ozonized solutions and blanks were seeded with 1 ppm filtered sewage treatment plant effluent, shielded from light and placed in shaking devices at 25 degrees. Samples were drawn and analyzed at different time periods for COD and TOC (total organic carbon) levels and changes in UV spectrum adsorption. Results showed that the efficiency of removal of non-ionic surfactants increased with increasing ozone doses. Biodegradation after ozonation resulted in overall removals of 70% COD and 62.5% of the TOC as compared with an 8 to 25% removal of COD and a 23% removal of TOC with biodegradation of the non-ozonized non-ionic surfactant. The enhanced biodegradability in ozonated preparations was attributed to changes in molecular structure of the non-ionic surfactant which were demonstrated in its UV spectrum and its chemical reaction with ammonium cobaltothiocyanate. (Geiger-FRC)
W81-00940

VARIATIONS IN WATER QUALITY DURING WINTER IN TWO YUKON RIVERS WITH EMPHASIS ON DISSOLVED OXYGEN CONCENTRATION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
H. Schreier, W. Erlebach, and L. Albright.
Water Research, Vol 14, No 9, p 1345-1351, September, 1980. 9 Fig, 2 Tab, 7 Ref.

Descriptors: *Rivers, *Dissolved oxygen, *Water quality, *Seasonal, *Ice cover, *Alaska, Sampling, Monitoring, Environmental effects, Trace metals, Nutrients, Fluctuations, Groundwater, Aeration, Alcan pipeline.

In view of the increasing development of energy sources in the Arctic and the lack of information on the baseline water quality of the rivers of this area, some winter variations in water quality were studied in an arctic and subarctic river basin in the Yukon Territory. This project was undertaken as part of the environmental impact analysis program for the Alcan pipeline conducted by the Department of the Environment, Inland Waters Directorate. The Swift River of the Southern Yukon and the Ogilvie River in the Northern Yukon Territory were sampled over a one year period for dissolved oxygen (DO), minerals, selected trace metals, nutrients, nitrogen, organic components, pH, and specific conductance. Depressions in DO were noted in both rivers during the winter when ice cover was present. In late winter, DO levels were the lowest while concentrations of basic cations were at a maximum. No relationships were found between oxygen levels and ice thickness or type. More groundwater low in DO was present as winter progressed and ice cover offered little chance for aeration. Other contributing factors to the low DO were oxygen uptake by suspended solids and by biota. These results support other studies showing low DO levels in Alaskan environments in the late winter. (Geiger-FRC)
W81-00943

RAIN WATER LEACHATES OF HEAVY METALS IN ROAD SURFACE SEDIMENTS,
Middlesex Polytechnic, London (England).
D. M. Revitt, and J. B. Ellis.
Water Research, Vol 14, No 10, p 1403-1407, October, 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Leaching, *Heavy metals, *Surface runoff, *Water pollution sources, *Drainage water, Storm water, Paving, Cadmium, Lead, Manganese, Toxicity, Particle size, Benthos, Sediments, Storm drains, Construction materials.

It has been shown that certain street surface sediments can contribute to the heavy metal pollution of stormwater drainage systems. The extractabilities of heavy metals from London street particles of different sizes were compared under simulated storm water flow conditions. Samples of street surface and roadside gutter sediments of separate catchment areas were examined for heavy metal leachability using rainwater of pH 6.5. Levels of Pb, Cd and Mn were determined by atomic absorption spectrophotometry in sediment preparations removed from rainwater after 1, 5, 11, 15, or 28 days. Solubility curves varied with time. Results of sorption and desorption experiments showed that Cd tended to desorb more rapidly from fractions with grain sizes greater than 250 micrometers. Heavy metal leachate patterns in areas of high and low motor vehicle traffic showed no significant differences. The overall extraction efficiency of Cd was found to be 10 times that of Mn which was, in turn, 100 times that of Pb. Mn showed the greatest potential for attaining equilibrium in rainwater samples. Under heavy storm conditions, enrichment of heavy metals through leaching from street pavings might cause toxic effects on benthic organisms. (Geiger-FRC)
W81-00950

APPLICATION OF TWO ATTENUATION MECHANISM THEORIES TO A SANITARY LANDFILL,
Wisconsin Dept. of Natural Resources, Madison, Bureau of Solid Waste Management.
For primary bibliographic entry see Field 5A.
W81-00959

CONTAMINATION OF FRESH WATER AQUIFERS BY OIL SPILLS,
Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
K. I. Kamath, J. Pasini, and B. J. Kush.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 174-186. 4 Fig, 3 Ref. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Contamination(Water), *Oil pollution, *Oily water, *Fluid flow, *Aquifers, Well drilling, Groundwater, Reservoirs(Oil), Water quality, Flow rates, Darcys Law.

The flow and distribution of spilled water-immiscible liquids within sand and gravel aquifers is discussed on the basis of the theory of multi-phase fluid flow through porous media and water well hydraulics. In an aquifer fully saturated with water, the flow is homogeneous or 'single-phase.' Air in the strata with the water is described as a 'two-phase' flow. The water can also be associated with immiscible or partially miscible liquid instead of air, thus altering the flow and posing potential water quality problems. Fluid flow sufficiently contaminated with oil can be in two distinct stages. In Stage I, the oil saturation at the contaminated section of the aquifer is above its residual value. Invasion by air of an oil-contaminated aquifer with a stabilized residual oil saturation represents Stage II. An oil spill will ultimately result in the dispersion of the oil into the aquifer pore systems as a 'residual' immobile phase, possibly modified by gravity effects. Aquifer contamination by buried 'oil wastes' is a serious problem and the damage may be irreversible. The problem of decontamination of an aquifer after an oil spill is nearly identical to that of the tertiary recovery of crude oil, but with even more constraints. Tertiary oil recovery also poses potential contamination situations. There are few practical inexpensive means to decontaminate affected aquifers except by drilling emergency wells to apply solvents or other fluids to the spill to recover and dispose of the contaminats. There is a need for preventive rather than curative methods for oil spill control. (Atkins-Omniplan)
W81-00963

THE NATURE AND EFFECTS OF COUNTY DRAINAGE DITCHES IN SOUTH CENTRAL MINNESOTA,
Mankato State Univ., MN. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4A.
W81-00976

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 4C.
W81-00978

UNDERGROUND RESIDENCE TIMES AND CHEMICAL QUALITY OF BASAL GROUND-WATER IN PEARL HARBOR AND HONOLULU AQUIFERS, OAHU, HAWAII,
Hawaii Univ., Honolulu.
T. H. Hufen, P. Eyre, and W. McConachie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-135444, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, Honolulu, University of Hawaii, Technical Report 129, February, 1980. 83 p, 1 Fig, 1 Tab, 24 Ref, 1 Append. 14-31-0001-3811.

Descriptors: *Hawaii, *Water pollution control, *Groundwater resources, *Aquifer management, *Aquifer testing, *Isotope studies, Time of concentration, Chemical analysis, Oil spills, Subsurface waters, Radioactive waste disposal, Underground storage, Contamination(Water), Organic compounds.

The deterioration in chemical quality of basal water with underlying saline water is of utmost concern on Oahu, where the Pearl Harbor and Honolulu groundwater systems constitute a primary source of fresh water. This study uses isotope and chemical analyses to investigate the storage and flow of the systems of six areas in southern Oahu. Potential origins of waters were determined by using mixing models and chemical compositions of water samples from sources located within a few miles of each other. Striking differences were found among the six areas; for example, underground residence times of basal waters in the Kalihi, Beretania and Moiliili systems are quite long in comparison to residence times of other systems. However, basal water in the Waialae system has a comparatively short residence time within the Honolulu systems. Many regions show the presence of transition-zone water, return irrigation water or caprock-type water, either singularly or in some combination. The study recommends preventive measures be taken to minimize the possible deterioration of Pearl Harbor basal water due to infiltration of manmade substances such as petroleum products or dangerous radioactive substances. The effect of agricultural activity on the chemical quality of Pearl Harbor basal water also needs further study. (Garrison-Omniplan)

W81-00982

5C. Effects Of Pollution

DIEL PATTERNS OF ICHTHYOPLANKTON LENGTH-DENSITY RELATIONSHIPS IN UPPER WATTS BAR RESERVOIR, TENNESSEE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. F. Cada, J. M. Loar, and K. D. Kumar.
In: Proceedings of the Fourth Annual Larval Fish Conference, February 27-28, 1980, Oxford, Mississippi, Fuiman, L. A., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/43, September, 1980, p 79-90. 4 Fig, 1 Tab, 9 Ref. W-7405-eng-26.

Descriptors: *Plankton, *Fish, *Larvae, *Sampling, Diel migration, Reservoirs, Fish populations, Fish behavior, Diurnal distribution, Vertical migration, Growth stages, Tennessee, Aquatic drift, Clupeids, *Bar Reservoir(TN).

Diel changes in drift rates bias the results of ichthyoplankton field studies which are restricted to day or night sampling, and these changes must be accounted for in investigations of fish populations or in assessment of water-use impacts. A diel ichthyoplankton sampling program was conducted in upper Watts Bar Reservoir, Tennessee, during 1978 to obtain information on diel changes in abundance of fish larvae in the planktonic drift and the extent of visually mediated sampling gear avoidance by motile larvae. Two-way analysis of variance tests revealed few significant diel differences in densities of individual taxa but showed consistently significant diel differences in mean total lengths of fish larvae. Clupeids in the 5 to 18 mm total length range were more abundant in surface samples during the day than during the night. Clupeid larvae either smaller or larger were relatively more abundant during the night. The greater nocturnal densities of larger larvae may be due to the inhibition of visual gear avoidance during the night. Although no direct evidence is available, diel vertical migration may also influence the observed patterns in size-specific, day-night density ratios. (Moore-SRC)
W81-00761

DETERMINATION OF THE VERTICAL DISTRIBUTION OF ICHTHYOPLANKTON IN LAKE NORMAN, NORTH CAROLINA, USING A DISCRETE-DEPTH SAMPLING DESIGN,
Duke Power Environmental Sciences Unit, Huntersville, NC.
R. E. Lewis, and J. R. Siler.
In: Proceedings of the Fourth Annual Larval Fish Conference, February 27-28, 1980, Oxford, Mississippi, Fuiman, L.A., Ed., Fish and Wildlife Service, Office of Biological Service, Report FWS/OBS-80/43, September, 1980, p 91-100. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Depth, *Sampling, *Larvae, *Fish, *Plankton, Spatial distribution, Lakes, Water temperature, Dissolved oxygen, North Carolina, Nuclear powerplants, Growth stages, Vertical distribution, Perches, Shad, Crappie, *Lake Norman(NC).

A vertical distribution study of larval shad, crappie, and percids in Lake Norman, North Carolina, was initiated in 1977 to: determine vertical distribution of ichthyoplankton in the vicinity of the McGuire Nuclear Station discharge during pre-operational and operational periods; compare vertical distribution with water temperature, dissolved oxygen concentration, and total length of individuals in each taxon; and address the suitablity of a discrete depth sampling design in meeting these objectives. Vertical distribtuion varied with length of individuals in each taxon and water temperature, but dissolved oxygen concentration did not appear to influence the vertical distribution. The discrete-depth sampling design, using 2.5 m depth increments, was adequate for comparing vertical distribution of larval fishes with physical variables. Although a precise estimate of larval fish density for the complete water column was not possible, changes in vertical distribution of ichthyoplankton were detected. (Moore-SRC)
W81-00762

DIEL, VERTICAL AND HORIZONTAL VARIATIONS IN ABUNDANCE OF LARVAL DOROSOMA SPP. IN CENTER HILL RESERVOIR, TENNESSEE,
Tennessee Cooperative Fishery Research Unit, Cookeville.
M. J. Van Den Avyle, and D. D. Fox.
In: Proceedings of the Fourth Annual Larval Fish Conference, February 27-28, 1980, Oxford, Mississippi, Fuiman, L.A., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/43, September, 1980, p 116-122. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Distribution, *Larvae, *Fish behavior, *Fish, Tennessee, Spatial distribution, Temporal distribution, Shad, Sampling, Reservoirs, *Center Hill Reservoir(TN).

Knowledge of spatial and diel variations in abundance of larval fishes is important for understanding fish behavior and for developing efficient sampling programs. Larval Dorosoma species were collected at five depths from one midchannel station and from the surface at two inshore stations during May and June 1979. Collections were made six times during each of three 24 hour periods. Catches were highest at night and lowest at midday, and the larvae were always most abundant in the surface or 2 m samples. Diel variations are believed to result primarily from changes in catchability rather than vertical migrations. Midchannel densities were lower than shoreline or nearshore densities during two of the three sampling periods. Median lengths of shad larvae showed no consistent vertical or diel patterns, but specimens collected along the shoreline were usually shorter than those collected at the midchannel station. (Moore-SRC)
W81-00763

SEASONAL OCCURRENCE, DISTRIBUTION, AND POWER PLANT ENTRAINMENT OF LARVAL FISHES IN PRESQUE ISLE HARBOR, LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
J. T. Hatch.
In: Proceedings of the Fourth Annual Larval Fish Conference, February 27-28, 1980, Oxford, Mississippi, Fuiman, L.A., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/43, September, 1980, p 123-135. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Lake Superior, *Entrainment, *Fish, *Larvae, *Distribution, Michigan, Powerplants, Plankton, Seasonal, Temporal distribution, Spatial distribution, Fish reproduction, Fish behavior, Limnology, Sculpins, Cisco, Smelts, Lake trout, Suckers, Perches.

As part of a study to assess effects of expansion and operation of the Presque Isle Power Station, Marquette, Michigan, on the aquatic biota of Presque Isle Harbor, Lake Superior, ichthyoplankton were collected from April 1975 through July 1976. Larval fishes were found in the harbor during all months except September, October, and November. Larvae of most taxa appeared only between April and August, but coregonines and fourhorn sculpin occurred from December to July, and December to June, respectively. In 1976, coregonines and fourhorn sculpin reached peak abundance about mid-May, followed by rainbow smelt in late May, lake trout and white sucker in early June, yellow perch in mid-June, burbot in late June, sculpins of the genus Cottus in mid-July, and ninespine stickleback in late July. Larvae of most taxa exhibited clumped distributions during their respective periods of peak abundance. total entrainment from August 1975 through 1976 was estimated at 8,800,000 larvae. Rainbow smelt, coregonines, fourhorn sculpin, and lake trout accounted for 92.8%, 3.4%, 1.5%, and 1.2% of this estimate, respectively. Entrainment appeared to be associated with seasonal succession of larvae, behavioral characteristics of larvae, and physical factors such as river discharge, harbor circulation, and wave action. (Moore-SRC)
W81-00764

COPPER PHARMACOKINETICS IN FISH GILLS-II. BODY SIZE RELATIONSHIPS FOR ACCUMULATION AND TOLERANCE,
Concordia Univ., Montreal (Quebec). Dept. of Biological Sciences.
P. D. Anderson, and P. A. Spear.
Water Research, Vol 14, No 8, p 1107-1111, August, 1980. 2 Fig, 4 Tab, 25 Ref.

Descriptors: *Fish, *Copper, *Kinetics, *Lethal limit, Rainbow trout, Sunfish, Metals, Chemical analysis, Bioassay, Water quality.

Lethal tolerance levels to copper were determined for two species of fish: a warm-water species, pumpkinseed sunfish (Lepomis gibbosus), and a cold water species, rainbow trout (Salmo gairdneri). The LC50 for sunfish increased disproportionately with body weight and varied as the reciprocal of copper accumulation rate in the gills. Thus, smaller sunfish accumulated copper at a greater rate, receiving a larger dosage per unit body weight, and were less tolerant to copper. In contrast, the body weight of rainbow trout had no effect on the LC50 and the accumulation rate of copper. It is suggested that a causal relationship exists between the amount of copper accumulated in gills and the lethal tolerance to copper. A comparison is made between the results of this study and other findings published on lethal tolerance levels. (McKeon-FRC)
W81-00768

HETEROTROPHIC BACTERIA IN TWO CANADIAN RIVERS-I. SEASONAL VARIATIONS IN THE PREDOMINANT BACTERIAL POPULATIONS,
New Brunswick Univ., Fredericton. Microbiology Research Lab.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Water Research, Vol 14, No 5, p 449-460, May, 1980. 8 Fig, 7 Tab, 55 Ref.

Descriptors: *Rivers, *Populations, *Nutrients, *Seasonal, *Aquatic bacteria, Water quality, Canada, Eutrophication, Monitoring, Chlorophyll, Photosyntheses, Fluctuations, Pseudomonas, Nitrogen fixing bacteria, Ice cover, Oligotrophy, Aquatic populations, Surface waters, Dissolved oxygen, Hydrogen ion concentration, Conductance, Temperature.

The Dunbar River, a small pristine woodland tributary of the St. John River, was monitored for seasonal variations in heterotrophic bacteria and physico-chemical water quality parameters from February 1977 to February 1978. Samples were drawn for analysis every other week. Temperature and oxygen levels were determined on site, and all other water parameters were determined at the Water Quality Laboratory of Environment Canada in Moncton, New Brunswick. Results were compared with those obtained in similar studies on the Meduxnekeag River, an upstream tributary of the St. John River. Both the Meduxnekeag and the Dunbar appeared oligotrophic, although the former received effluents of domestic and industrial wastewaters. A toxometric approach coupled with multivariate statistical analysis of bacterial populations showed a predominance of fluorescent Pseudomonas spp. Bacterial populations were largely psychrotrophs, and their numbers were limited by nitrogen. Temperature had a strong influence on in situ heterotrophic activity. Both rivers had ice covers for 5 months, during which the dissimilation of nitrate was increased. (Geiger-FRC)
W81-00770

THE EFFECT OF PHOTOCHEMICAL TREATMENT OF WATER ON ALGAL GROWTH,
Volcani Inst. of Agricultrual Research, Bet-Dagan (Israel). Inst. of Soil and Water.

For primary bibliographic entry see Field 4A.
W81-00771

INTERACTING LIMITS TO ALGAL GROWTH: LIGHT, PHOSPHORUS, AND CARBON DIOXIDE AVAILABILITY,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, and D. L. King.
Water Research, Vol 14, No 5, p 409-412, May, 1980. 3 Fig, 27 Ref.

Descriptors: *Eutrophication, *Aquatic algae, *Nutrients, *Limiting factors, Environmental effects, Plant growth, Light intensity, Phosphorus, Carbon dioxide, Nuisance algae.

New information regarding the interactions between some commonly recognized factors which limit algal growth is discussed with a view to adding to knowledge of the mechanisms of eutrophication and to contributing to the development of strategies to control its adverse impacts. Some of these factors include light, phosphorus, and carbon dioxide availability. A cyanophyte, Anacystis nidulans, was grown under conditions which gave a range of growth limitation for each of these factors. The effects of the three limiting factors on algal growth were readily apparent and demonstrate the existence of a positive interaction between light, phosphorus and carbon dioxide as regulators of algal carbon fixation. Algae incubated at high light with ample phosphorus grew faster over a wider range of carbon dioxide concentrations and a lower concentration of carbon dioxide than did algae grown under other conditions. Algae incubated at low light with only limited phosphorus grew at a lower rate over a narrower range of concentrations of carbon dioxide, and ceased growth at a higher concentration of carbon dioxide compared to other conditions. An initial dependence on the amount of illumination was noted in each study. The results suggest that interactions between limiting factors can be important in determining the rate and amount of algal growth in freshwater ecosystems. (Baker-FRC)
W81-00777

ACUTE TOXICITY AND BEHAVIORAL RESPONSES OF COHO SALMON (ONCORHYNCHUS KISUTCH) AND SHINER PERCH (CYMATOGASTER AGGREGATA) TO CHLORINE IN HEATED SEA-WATER.
Washington Univ., Seattle. Fisheries Research Inst.
Q. J. Stober, P. A. Dinnel, E. F. Hurlburt, and D. H. DiJulio.
Water Research, Vol 14, No 4, p 347-354, April, 1980. 5 Fig, 3 Tab, 3 Ref.

Descriptors: *Coho salmon, *Shiner perch, *Chlorine, *Thermal waters, Fish, Fish attractants, Fish behavior, Fish repellents, Toxicity, Bioassay, Effluents, Statistics, Sea water, Heated water.

The acute toxicity and behavioral responses of 1-yr-old coho salmon and 1-3-mo-old shiner perch to chlorinated sea-water at 13, 16, and 20C were determined. Both species were exposed to chlorine concentrations of 0.077-1.035 mg/liter, as measured by total residual oxidant (TRO), for 7.5, 15, 30, and 60 min. Shiner perch did not survive exposures exceeding 1.0 mg/liter TRO for 7.5 min. All survived a 60 min exposure at TRO concentrations of < 0.2 mg/liter. Coho salmon did not survive an exposure of 7.5 min at 0.5 mg/liter TRO or more. A survival of 100% after 60 min was observed at TRO concentrations of < 0.1 mg/liter. The mean 60 min LC50 for shiner perch was significantly reduced ($P < or = 0.05$), from 308 microg/liter TRO at 13C to 230 microg/liter at 20C. The 60 min LC50 for coho salmon decreased from 208 microg/liter TRO at 13C to 130 microg/liter at 20C. Coho salmon consistently avoided chlorine at all test concentrations from 2 to 500 microg/liter. Increased temperatures reinforced this response. A significant avoidance threshold was observed for shiner perch at 175 microg/liter TRO, while a significant preference response occurred at concentrations of from 10 to 100 microg/liter at 16 and 20C. This study indicates that the discharge of chlorinated effluents into sea-water may be attractive to some resident marine populations. (McKeon-FRC)
W81-00786

A PRESSURIZED PROPORTIONAL DILUTER FOR AQUATIC TOXICOLOGICAL STUDIES,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
M. J. Hemmer.
Water Research, Vol 14, No 3, p 243-246, March, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Equipment, *Siphon, *Testing procedures, Analytical techniques, *Toxcity, Chlorinated hydrocarbon pestcides, Pumps, Carbamate pesticides, Pesticide toxicity, Laboratory tests, Sampling, Aquatic animals, Water pollution effects.

A proportional diluter which was recommended for use in routine aquatic toxicity tests by the committee on Methods for Toxicity Test With Aquatic Organisms (1975) is described. The half-liter proportional diluter uses positive pressure, with its primary siphons being activated by a pulse of pressure instead of by a partial vacuum as in conventional diluters. The need for venturi tubes, vacuum manifolds, and individual water blocks is eliminated by the device. Pressure is delivered through air cylinders, air compressor lines or air pumps. Performance evaluations of the diluter were conducted in 96-hour acute toxicity tests to the grass shrimp, Palaemonetes pugio, exposed to the organochlorine pesticide, endrin, or the carbamate pesticide, sevin. Recoveries of the pesticides from seawater samples wer greater than 90%. Other advantages of the proportional diluter include its ease of construction, calibration and cleaning, its low cost, compact size, and ability to conserve water. (Geiger-FRC)
W81-00795

A COMPARISON OF THE INFLUENCE OF IRON ON THE GROWTH AND NITRATE METABOLISM OF ANABAENA AND SCENEDESMUS,
State Univ. of New York at Fredonia.
D. R. Verstreate, T. A. Storch, and V. L. Dunham.
Physiologia Plantarum, Vol 50, p 47-51, 1980. 2 Fig, 4 Tab, 20 Ref. OWRT-B-074-NY(1), 14-34-0001-8102.

Descriptors: *Iron, Effects, *Growth rates, *Algae, *Cyanophyta, *Chlorophyta, Nitrate assimilation, Glutamine synthetase, Anabaena flos-aquae, Scenedesmus bijugatus.

A comparative study of growth and nitrate metabolism of Anabaena flosaquae (Lyng.) Breb, and Scenedesmus bijugatus var. seriatus Chodat investigated possible mechanisms for the iron-stimulated increases in growth specific for blue-green algae in mixed algal communities. Algae were separately grown in an inorganic medium with varying concentrations of iron and nitrate to determine the effects on each organism. Iron was found to be a limiting nutrient for cultures of both Anabaena and Scenedesmus as determined by chlorophyll a concentrations and cell enumeration. Both iron and nitrate stimulated the specific activity of nitrate reductase, nitrite reductase, and glutamine synthetase in Anabaena. Iron enrichment did not increase the activity of the enzymes in Scenedesmus, but inhibited the activity of nitrate reductase and glutamine synthetase. The stimulation of growth by iron in cells grown under iron limiting conditions was associated with increased nitrate metabolism in Anabaena but not in Scenedesmus.
W81-00808

ROLE OF THE U.S. FISH AND WILDLIFE SERVICE IN PUMPED STORAGE POWER PLANT PROJECTS,
National Power Plant Team, Ann Arbor, MI.
J. Boreman.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 4-11. 4 Tab.

Descriptors: *Pumped storage, *Hydroelectric plants, *Environmental effects, *Wildlife, Water quality, Aquatic life, Streamflow, Methodology, Decision making, Permits, Information exchange, Fish, Habitats, Migration, Fish and Wildlife Service.

The construction and operation of pumped storage projects pose a threat to the well-being of the fish and wildlife resources of the United States. This threat results from potential environmental impacts such as entrainment and impingement of aquatic organisms, degradation of water quality, alteration of natural stream flows, removal of terrestrial habitat, and interference with migration pathways. The U.S. Fish and Wildlife Service is currently involved with pumped storage projects in two areas: review of license and permit applications, and research and development of information that can be used to minimize project impacts. To increase the effectiveness of this involvement, in the future the Fish and Wildlife Service will emphasize three areas of effort: development of an environmental information base, timely dissemination of information and methodologies to decision makers, and evaluation of the usefulness of the disseminated information and methodologies. (Moore-SRC)
W81-00839

THE KEOWEE-TOXAWAY PROJECT,
Duke Power Co., Charlotte. NC.
J. S. Garton.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 12-20. 6 Fig, 1 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Water temperature, *Reservoirs, Thermal stratification, Hydraulic structures, Weirs, Dams, Reservoir design, Trout, South Carolina, Nuclear powerplants, Aquatic habitats, Environmental effects, *Keowee-Toxaway Project(SC).

The Keowee-Toxaway Project is located in the foothills and mountains of northwestern South Carolina. The project consists of a system of impoundments and power facilities including Keowee and Jocassee Reservoirs, the three-unit Oconee Nuclear Station, a conventional hydroelectric station at the Keowee dam, and a pumped storage hydroelectric station at the Jocassee dam. Each impoundment and power facility is briefly described. Representative water temperature profiles, both preoperational and operational, are given for each impoundment that indicate the general effects of project operations on thermal conditions. The design of these power plants includes a skimmer wall and submerged weirs that result in selective use of reservoir water for different functions. In Keowee Reservoir during summer the lower strata are warmed noticeably above preoperation conditions, and during winter temperatures cool to within a few degrees of the preoperation condition. The effect of pumped storage operations has been to lower the upper boundary of suitable trout habitat in Jocassee Reservoir. An additional pumped storage station, Bad Creek, is scheduled for construction above Jocassee Reservoir. In order to reduce the probability that the flows from the Bad Creek station will erode the trout habitat in Jocassee Reservoir through destratification, a submerged weir will be placed downstream of the discharge. (Moore-SRC)
W81-00840

PREDICTIONS OF EFFECTS OF PUMPED STORAGE HYDROELECTRIC OPERATIONS ON TROUT HABITAT IN JOCASSEE RESERVOIR, SOUTH CAROLINA,
Fish and Wildlife Service, Clemson, SC. Southeast Reservoir Investigations.
J. L. Oliver, and P. L. Hudson.

In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 21-25. 2 Tab, 6 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Trout, *Water temperature, Reservoirs, Aquatic habitats, Dissolved oxygen, Winter, Thermal stratification, South Carolina, Turnovers, Forecasting, Environmental effects, *Jocassee Reservoir(SC).

Jocassee Reservoir is the upper pool for the Jocassee Pumped Storage Station. Keowee Reservoir serves as the lower pool and as a cooling reservoir for the Oconee Nuclear Station. Although Jocassee reservoir supports an excellent fishery for both trout and warmwater species, increased operation of the power stations has resulted in a continual decline in the volume of trout habitat from 1973 to 1976. Temperature and dissolved oxygen profiles were taken monthly at three stations in Jocassee Reservoir since August 1973 and at one station in the tailwaters since April 1972. Two regression equations describing the effect of pumped storage operations were developed: both estimate the volume of trout habitat during the most critical period of the summer, before fall overturn. Various combinations of minimum winter water temperature (MWWT) and pumping volumes were used to predict September trout habitat. On the basis of estimated 1985 and 1991 pumping volumes it is estimated that trout habitat will be present in those years after cold winters, but that it may be nearly or completely eliminated after a typical or warm winter. (Moore-SRC)
W81-00841

ENTRAINMENT OF ICHTHYOPLANKTON AT JOCASSEE PUMPED STORAGE STATION,
Fish and Wildlife Service, Clemson, SC. Southeast Reservoir Investigations.
E. D. Prince, and L. J. Mengel.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J. P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 26-39. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Entrainment, *Larvae, *Fish, Reservoir operation effects, South Carolina, Mortality, Penstocks, Reservoirs, Diel migration, Ecology, Jocassee pumped storage station(SC).

The entrainment of larval fish at Jocassee pumped Storage Station, South Carolina, has been studied since April 1977 to evaluate the effects of power plant operations on fish populations. Duplicate weekly samples of fish larvae were taken in 1977 during generation and pumping using plankton nets. A frame trawl has been used to sample larval fish throughout the upper and lower reservoirs and to assess diel depth distribution at both ends of the penstocks. About six times more larvel fish were entrained during pumping than during generation in 1977. The differences in the densities of larvel fish passing through the pumped storage station during different modes of operation appear to be related to three major factors: configuration of the basin surrounding the penstock openings; diel depth distribution of the fish larvae; and times of day during which the plant operated. About 7% of the larval clupeids in Keowee Reservoir were killed due to operation of the pumping mode in 1977. (Moore-SRC)
W81-00842

REVIEW OF THE LITERATURE ON THE EFFECTS OF PUMPED STORAGE OPERATIONS ON ICHTHYOFAUNA,
Georgia Power Co., Atlanta.
R. D. Miracle, and J. A. Gardner, Jr.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 40-53. 71 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Fish, *Mortality, Reservoir operation effects, Ecology, Aquatic habitats, Water temperature, Dissolved oxygen, Velocity, Water levels, Reservoirs, Entrainment, Animal pathology, Pressure, Growth stages.

Pumped storage operations pass large volumes of water from one reservoir to another, ultimately affecting fishes, either by entrainment in withdrawn waters or by modification of the aquatic environment. Mortality caused during entrainment is primarily due to the following physical stresses: abrasion and collision; pressure changes; velocity changes; and acceleration effects. Fish passage or entrainment is influenced by: size and life stage of fish; susceptibility of the fish which directly relates to life history aspects; and physical characteristics of the pumped storage facility. Pumped storage facilities can adversely affect reservoir hydrology through changes in water level, water temperature, dissolved oxygen and water velocity. Although adverse effects of pumped storage can be severe when drastic modifications result from plant operations, most fish populations are able to adapt to the changing environments encountered at facilities in the United States. (Moore-SRC)
W81-00843

STUDIES OF THE EFFECTS OF OPERATING THE MT. ELBERT PUMPED STORAGE POWERPLANT,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
J. F. LaBounty, and R. A. Roline.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J. P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80-28, April, 1980, p 54-66. 3 Fig, 1 Tab, 38 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Aquatic habitats, Reservoir operation effects, Ecology, Mortality, Aquatic life, Limnology, Fish, Shrimp, Sampling, Lake sediments, Ecosystems, Colorado, *Twin Lakes(CO).

The Mt. Elbert Pumped Storage Powerplant is located on the northwest shore of the lower lake of Twin Lakes near Leadville, Colorado. Construction of the powerplant started in February 1972, and initial operation of the first of two units is planned for 1981. In 1971, the Water and Power Resources Service initiated studies to obtain limnological and fishery data in an attempt to better understand the environmental impacts of pumped storage. Past, ongoing, and planned research on the Twin Lakes ecosystem is reviewed. Expected impacts resulting from powerplant operation include fish and mysis shrimp mortality, stirring of lake sediments, and changes in the physical environment of Twin Lakes. To assess and quantify the impacts of pumped storage on Twin Lakes biota, sampling facilities in the tailrace of the lower lake and in the Mt. Elbert forebay are being designed and constructed. These structures and techniques will allow sampling of aquatic organisms at any time during the pumping and generation modes of the powerplant. (Moore-SRC)
W81-00844

PREOPERATIONAL FISHERY INVESTIGATIONS OF TWIN LAKES, COLORADO,
Colorado Div. of Wildlife, Buena Vista.
T. P. Nesler.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 67-79. 6 Fig, 3 Tab, 8 Ref.

Descriptors: *Pumped storage, *Sport fishing, *Rainbow trout, *Lake trout, Creel census, Baseline studies, Fish populations, Reservoirs, Ice fishing, Lake fisheries, Sampling, Colorado, *Twin Lakes(CO).

Twin Lakes, near Leadville, Colorado, is the first of Colorado's reservoirs to be developed as a pumped storage site. The fishery at Twin Lakes can be classified into two major components: stocked rainbow trout fishery during the open-water season, and lake trout during the ice fishing season. Because of the potential impact of pumped storage operations on the sport-fishing harvest, a creel census and a standardized program of gillnet sampling were initiated in 1973. Annual harvests of rainbow trout for both lakes during the open-water season ranged from over 25,000 to 43,000 during 1974-1977, and over 81,000 in 1973. Lake trout harvested in 1974-1977 ranged from 1,000 to 1,500 fish. Fishermen-hours on the lower lake were approximately 2-3 times greater than estimates for the upper lake. On the lower lake, the catch rate for shore fishermen ranged from 0.25-0.44 fish per man-hour, and for boat fisherman ranged from 0.17-0.27 fish man-hour. With the exception of one season, ice fishing catch rates ranged from 0.11-0.14 fish per man-hour and lake trout composed 89% or more of the total harvest. (Moore-SRC)
W81-00845

SUMMARY OF ECOLOGICAL STUDIES OF FISHES IN MUDDY RUN PUMPED STORAGE POND, PENNSYLVANIA,
Radiation Management Corp., Drumore, PA.
P. G. Heisey, and D. Mathur.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 80-94. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Fish populations, *Ecology, Reservoirs, Fish reproduction, Mortality, Entrainment, Pennsylvania, Muddy Run pumped storage pond(PA), Conowingo Pond(PA).

Muddy Run Pumped Storage Pond and Conowingo Pond are located in southeastern Pennsylvania. Most water for Muddy Run is drawn form Conowingo. Most of the fish species inhabiting the lower pond (Conowingo) were entrained by the Muddy Run Station soon after it commenced operation; however, fish entrainment and mortality at Muddy Run Station had little impact on fish populations in Conowingo. Variations in abundance of many common fishes in Conowingo appear to depend upon success or failure of individual year classes and not on operation of Muddy Run Station. Total standing crop of fishes in Muddy Run compares favorably with that from numerous non-pumped storage reservoirs except for sunfishes and crappies. Data collected in recent years indicate that a more favorable game fish to rough fish ratio is developing in Muddy Run. Reproductive success of most fishes in Muddy Run was limited by water level fluctuations. Numerous fish appear to be recruited from a constant elevation lake set aside for recreation. (Moore-SRC)
W81-00846

WATER QUALITY AT THE TVA RACCOON MOUNTAIN PUMPED STORAGE PLANT,
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
H. Olem, and L. H. Woosley, Jr.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 95-108. 9 Fig, 4 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Dissolved oxygen, *Reservoirs, Stratification, *Water quality, Hydrogen ion concentration, Aquatic productivity, Diurnal, Tennessee, *Raccoon Mountain pumped storage plant(TN).

The Raccoon Mountain Pumped Storage Plant, just west of Chattanooga, Tennessee, has been providing peaking and reserve capacity requirements to the Tennessee Valley Authority power system since 1978. Because of the potential for low concentrations of dissolved oxygen in releases from the upper reservoir having a significant impact on the water quality of the lower reservoir, Nickajack Lake, the water quality in the upper reservoir and in reservoir releases is investigated. Operation of the Raccoon Mountain Plant on a routine basis did not result in releases of water containing dissolved oxygen concentrations below 4.0 mg/l. When water released from the upper reservoir was below 5.0 mg/l, the calculated decrease in dissolved oxygen in Nickajack Lake after mixing was less than 5%. The newly formed upper reservoir exhibited dissolved oxygen stratification in the upper layer during routine summer operation in 1979 due to a biologically productive surface layer. Dissolved oxygen concentrations between 8.9 and 11.4 mg/l were measured in the upper three meters. Diurnal fluctuations of pH and dissolved oxygen in the upper layer of the upper reservoir were observed during routine summer operation. (Moore-SRC).
W81-00847

EFFECTS OF PUMPBACK STORAGE ON ZOOPLANKTON POPULATIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA.
A. L. Buikema, Jr., and P. H. Loeffelman.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 109-124. 10 Fig, 22 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Thermal statification, *Zooplankton, Virginia, Water temperature, Crustaceans, Rotifers, Aquatic animals, Limnology, Predation, *Smith Mountain Lake(VA).

The impact of pumped storage operations on the aquatic mirofauna of impoundments was investigated at Smith Mountain Lake, a mainstream pumped storage complex southeast of Roanoke, Virginia. Smith Mountain Lake was sampled for zooplankton and water temperature at four stations once a month for 13 months and then at two stations once a day for seven days. The most obvious effect of pumpback on temperature was disruption of thermal stratification in the forebay. Thermal layers fluctuated greatly, and isolated lenses of water of differing temperature were apparent. A total of 1088 pump samples and 104 tow samples were qualitatively and quantitatively analyzed for zooplankton. Forty-nine species of rotifers, 15 species of Cladocera, and 8 species of copepods were identified. It appears that the interaction of pumped storage operation and zooplankton populations in Smith Mountain Lake is very complex. Pumpback appears to stimulate predation, and normal thermal characteristics of the lake were altered to the apparent benefit of the zooplankton. (Moore-SRC)
W81-00848

A MATHEMATICAL MODEL TO ASSESS THE EFFECTS OF PASSAGE OF ZOOPLANKTON ON THEIR RESPECTIVE POPULATIONS,
Stone and Webster Engineering Corp., Boston, MA.
T. J. Horst.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumed Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 177-189. 9 Fig, 3 Tab, 7 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Mathematical models, *Zooplankton, *Mortality, Limnology, Aquatic animals, Entrainment, Crustaceans, Sweden, *Lake Ivosjon(Sweden).

A mathematical model is used to study the operational effects of the proposed Vastana pumped storage plant on the Lake Ivosjon, Sweden, ecosystem by assessing the effects of withdrawal and discharge of water on zooplankton. Bosmina coregoni was selected as representative of zooplankton with a relatively rapid development time and Eudiaptomus graciloides was selected as the representative of long-lived zooplankton. A series of simulations was conducted to assess the effects of power plant operation on the populations of the zooplankters. Mortality values of 10%, 50%, and 100% were used for entrainment mortality. The percent reduction in the Bosmina population was 2% for the low entrainment mortality, and 8 to 12% for the assumption of total mortality of entrained organisms. The percent reduction in the Eudiaptomus population was 2% for the low entrainment mortality and 9 to 16% for the assumption of total entrainment mortality. Except for the most extreme cases simulated, the predictions fall within the range of measured variation. Based on this study, the proposed Vastana plant is expected to have a tolerable effect on the lake ecosystem. (Moore-SRC)
W81-00852

TOXIC SUBSTANCES FROM FRESHWATER ALGAE,
Alberta Univ., Edmonton. Dept. of Botany.
P. R. Gorham, and W. W. Carmichael.
Progress in Water Technology, Vol 12, No 2, p 189-198, 1980. 1 Fig, 3 Tab, 36 Ref.

Descriptors: *Cyanophyta, *Eutrophication, *Algal toxins, *Scum, *Poisons, Toxicity, Freshwater, Animal groupings, Chemicals, Chemical properties.

Toxins isolated from strains of freshwater planktonic blue-green algae are discussed including their structure and toxicity. Known Microcystis toxins are either a fast-acting/low-molecular weight alkaloid or a slow-acting, comparatively small polypeptide. Toxins isolated from Anabaena and Aphanizomenon strains are fast-acting, low-molecular weight alkaloids. Recent research has identified toxins from Anabaena and Microcystis that are different from ones studied earlier. A pteridine toxin has been isolated from a strain of Synechococcus. Poisoning by freshwater blue-green algae is now better understood because of these findings. To cause poisoning, a waterbloom or scum must have a relative proportion of one or more toxic strains that equals or exceeds a poisonous threshold value and maintain this composition of species for a period of time. The threshold will differ with the species and strains of toxic algae involved, the amounts ingested, and the target animals. Achieving and maintaining toxic levels depends on growth conditions, phytoplankton and zooplankton, decomposition and detoxification mechanisms, lysis, agglomeration, and others. (Small-FRC)
W81-00855

THE SIGNIFICANCE OF THE PREDATOR FOOD CHAIN IN LAKE METABOLISM,
Trondheim Univ. (Norway). Zoological Dept.
A. Langeland, and P. Larsson.
Progress in Water Technology, Vol 12, No 2, p 181-187, 1980. 1 Fig, 29 Ref.

Descriptors: *Zooplankton, *Eutrophication, *Fish populations, *Predation, *Lakes, Biological communities, Primary productivity, Phytoplankton, Cyanophyta, Europe, Food chains.

Selective fishing as a biological tool in the control of eutrophication of lakes is discussed. Field studies are cited to demonstrate the significance of the predator food chain in lakes. Increased self-purification has been reported in serveral limnetic water bodies when large filter feeding cladocerans were allowed to increase their populations. Fish predation reduces the size of zooplankton populations, causing less efficient grazing on phytoplankton. In most cases when large cladoceran populations develop, the general phytoplankton biomass is reduced. There is also usually a reduction in the amount of blue green algae. An additional positive factor is that the fish may be harvested and serve as a food for man. (Small-FRC)
W81-00856

EFFECTS OF EUTROPHICATION ON ZOOPLANKTON,
Commission of the European Communities, Ispra (Italy). Physical and Natural Sciences Dept.
O. Ravera.
Progress in Water Technology, Vol 12, No 2, p 141-159, 1980. 1 Fig, 3 Tab, 61 Ref.

Descriptors: *Zooplankton, *Eutrophication, *Methodology, *On-site investigations, Lake stages, Nutrients, Water pollution effects, Industrial wastes, Predation, Cladocerans, Reviews.

A review is presented of the methodologic difficulties and the uncertainty in interpreting results of studies on the variation of zooplankton with eutrophication. Two methods are normally used: a comparison of characteristics of zooplankton within the same body of water as eutrophication levels change, and comparison of zooplankton in different bodies of water with different levels of trophy. Zooplankton samples are collected from sediment cores, and Cladocerans are usually studied. The influence of phytoplankton, the effects of predation, and the succession of species are discussed. Because of the combined influences of nutrient enrichment, industrial pollution, and the introduction of planktivore fish on zooplankton communities, it can be difficult to determine the effects of eutrophication. The most successful studies apply different methods to the same body of water to obtain a more complete picture of zooplankton changes. (Small-FRC)
W81-00857

THE INFLUENCE OF EUTROPHICATION ON DEEP LAKE BENTHIC INVERTEBRATE COMMUNITIES,
Bergen Univ. (Norway). Zoological Museum.
O. A. Saether.
Progress in Water Technology, Vol 12, No 2, p 161-180, 1980. 8 Fig, 1 Tab, 53 Ref.

Descriptors: *Zooplankton, *Eutrophication, *Lakes, *Succession, Biological communities, Great lakes, Phosphorus, Lake stages, Europe, Water pollution effects, Oligochaetes, Chironomids.

Case histories are presented of eutrophication in the following deep lakes: Vattern, Malaren, Constance, Geneva, Maggiore, Mergazzo, Taho, the Great Lakes, and the Okanagan Lakes. In most of these lakes the first reaction to eutrophication was an increase in abolute and relative amounts of oligochaetes without any change in species composition. Shaeriids, large crustaceans, and chironomids also increased in number. Further, there is a shift in relative abundance of common species. When a strongly oligotrophic lake changes to a less strongly oligotrophic lake, only species of chironomids may be eliminated from the profundal zone. A study of characteristic chironomids in lakes of different trophic levels indicated 15 subdivisions of communities. A significant correlation was found between the 15 subdivisions and chlorophyll a/mean depth and between subdivisions and total phosphorus/mean depth. These correlations indicate that while it is easy to change benthic communities from ultraoligotrophic to moderately oligotrophic, it takes higher shifts in primary production to change oligotrophic to mesotrophic or mesotrophic to eutrophic. More primary production is needed to change the benthic communities as the depth of the lake increases. (Small-FRC)
W81-00858

BLUE-GREEN ALGAE IN LAKE MJOSA AND OTHER NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
O. M. Skulberg.
Progress in Water Technology, Vol. 12, No 2, p 121-140, 1980. 13 Fig, 1 Tab, 35 Ref.

Descriptors: *Eutrophication, *Lakes, *Nutrients, *Algal control, Algae, Water quality, Aquatic environment, Water properties, Phosphorus, Water pollution, Lake Mjosa, Norway.

Various lakes in Norway were investigated to determine increases in blue-green algae resulting from human activities that have changed the oligotrophic conditions of the waters. These activities include waste disposal and agriculturally related pollution. The trophic nature of inland waters is closely linked with the growth of planktonic algae. Evidence of trophic changes in algal growth includes variations in the major components of phytoplankton, studied from May through November of 1976. In some regions of Norway, eutrophication has been associated with invasions of planktonic species of Oscillatoria which are able to develop dense populations in lakes and slow flowing rivers. Climatic conditions also influence phytoplankton development. It is concluded from current research that an invasion of blue-green algae occurs under disturbed ecological conditions. Eutrophication provides a sequence of events leading to mass development of vegetation with blue-green algae. Eutrophication is a continuous and coherent phenomenon, and thus control measures must concentrate on local reservoirs of the blue-green algae. (Baker-FRC)
W81-00859

THE CASE OF LAKE MJOSA,
Norsk Inst. for Vannforskning, Oslo.
H. Holtan.
Progress in Water Technology, Vol 12, No 2, p 103-120, 1980. 13 Fig, 4 Tab, 45 Ref.

Descriptors: *Eutrophication, *Lakes, *Nutrients, *Algal control, Water qulaity, Aquatic environment, Water properties, Phosphorus, Nitrogen, Algae, Lake Mjosa, Norway.

Lake Mjosa is located 121 m above sea level and has a surface area of 365 square km, an average water depth of 153 m, maximum depth of 447 m, and a volume of about 56 cubic km. The lake with several tributary valleys extends far into Norway's largest mountain area, Jotunheimen. The total phosphorus supplied to the lake in tons per year for 1973 through 1977 ranged from 396.8 to 218.9 tons. Samples were taken from the lake four times a year from 1966 to 1974 to perform eutrophication studies. Eutrophication is occurring as a result of continuously increasing supplies of nutrients and other growth stimulating substances entering the lake. The phosphourus load is not the only problem. Increasing supplies of nitrogen and nitrate have also been noted. The phytoplankton biomass in general has consisted of diatoms, but in the latter part of 1976 summer season the blue-green alga Oscillatoria bornetii fa. tenuis became dominant. A plan has been drawn up for restoration of the water and is described. (Baker-FRC)
W81-00860

EUTROPHICATION OF ALPINE LAKES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung Und Gewaesserschutz, Zurich (Switzerland).
H. Ambuhl.
Progress in Water Technology, Vol 12, No 2, p 89-101, 1980. 8 Fig, 2 Tab, 1 Ref.

Descriptors: *Eutrophication, *Lakes, *Nutrients, Water quality, Limnology, Aquatic environment, Water properties, Oxygen, Phosphorus, Alpine lakes, Switzerland.

Eutrophication is discussed as it occurs in alpine lakes which are strongly influenced by their mountainous surroundings, many being relatively deep, quite steep walled, and in certain cases even typical of fjord lakes with partly tectonic origin. Phosphorus plays the major role in determining the extent of photosynthesis in lakes. The load of phosphate which leads to eutrophication depends on various parameters including local climate, wind exposure, morphometry, retention time and others. Some general comments on phosphorus loading of alpine lakes are given. It is noted that the existence of dissolved oxygen in the near-bottom water does not necessarily exclude the possiblity of phosphorus release from the sediment into the waterbody, which thus leads to self-fertilization of the lake. Morphometric and hydrographic data are given for several lakes. The vertical distribution of the oxygen content in Swiss lakes at the end of the summer stagnation for 1965-1975 is graphed. The possibility of restoration of small and hallow lakes by lowering phosphorus load and by internal lake measures such as aeration, hypolimnion drainage and others is considered. (Baker-FRC)
W81-00861

APPLICATION OF US OECD EUTROPHICATION STUDY RESULTS TO DEEP LAKES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Progress in Water Technology, Vol 12, No 2, p 81-88, 1980. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Eutrophication, *Lakes, *Model studies, Aquatic environment, Water properties, Algal control, Algae, US OECD eutrophication model, Norway, Lake Mjosa.

The US portion of the OECD eutrophication study was recently completed and applied to a deep Norwegian lake, Lake Mjosa. This portion of the OECD nutrient load-eutrophication response model demonstrated that the Vollenweider approach of using phosphorus load normalized by mean depth and hydraulic residence time to predict the planktonic algal chlorophyll in the waterbody is valid for a wide variety of waterbodies. This particular lake shows the same normalized phosphorus load-planktonic algal chlorophyll relationships. It is concluded that the OECD eutrophication modeling approach and the nutrient load-eutrophication response relationships developed by Vollenweider and expanded by the US together present a powerful tool to assess the impact of eutrophication control programs. Water quality managers will be able to predict with a high degree of reliability the changes in water quality that will occur as a result of reducing the phosphorus input to a waterbody by a certain magnitude. (Baker-FRC).
W81-00862

QUANTIFYING THE EUTROPHICATION PROCESS: DIFFICULTIES CAUSED, FOR EXAMPLE, BY SEDIMENTS,
For primary bibliographic entry see Field 2K.
W81-00863

EUTROPHICATION IN RELATION TO THE LOAD OF POLLUTION,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 2K.
W81-00883

EUTROPHICATION OF NORWEGIAN FRESHWATERS IN RELATION TO NATURAL CONDITIONS,
Oslo Univ. (Norway).
J. Kjensmo.
Progress in Water Technology, Vol 12, No 2, p 39-47, 1980. 4 Tab, 17 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Glacial soils, Bedrock, Soil chemistry, Soil structure, Soil types, Rocks, Glacial sediments, *Norway, Lakes, Rivers.

The natural supply of phosphorus to Norwegian fresh water is considered. The most important natural source for phosphorus supply is the rocks and soils in the drainage areas of lakes and rivers. The bulk of phosphorus in rock is in the form of apatite. Surface soil layers are often rich in phosphorus due to the plant detritus in various stages of decomposition. Total phosphorus levels in 14 Norwegian lakes were determined. The range is from 3.8 to 5.8 micrograms/liter in a group of Permian lakes. Two humic influenced lakes which are situated in Pre-Eocambrian and Eocambrain rocks have total P contents of 8.8 and 10.3 micrograms/liter, respectively. The export of total P from the watersheds of some Norwegian rivers ranges from 4.0 to 57.3 mg/sq m/year. The annual average export derived from 7 watersheds which consist mainly of forested and unproductive igneous areas was found to be 7.2 mg/sq m/year. The findings in rivers and lakes studied demonstrate the large scale of natural oligotrophic features in the watersheds of Norway. (Baker-FRC)
W81-00884

SANITARY AND AESTHETIC QUALITY OF THE COASTAL WATERS OF SPAIN,
Ministry of Public Health and Social Security, Madrid (Spain).
For primary bibliographic entry see Field 5B.
W81-00888

COMBINED EFFECTS OF DODECYL BENZENE SULFONATE AND LOW SALINITIES ON TISBE BULBISETOSA (COPEPODA: HARPACTICOIDA),
National Research Council, Venice (Italy). Inst. of Marine Biology.
L. Dalla Venezia, V. U. Fossato, and S. Scarfi.
Progress in Water Technology, Vol 12, No 1, p 109-117, 1980. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Toxicity, *Laboratory tests, *Alkylbenzene sulfonates, *Salinity, Water pollution, Water pollution effects, Sea water, Invertebrates, Tisbe bulbisetosa.

Laboratory experiments analyzed the effects of four concentrations of dodecyl benzene sulfonate (DBS), a component of commercial detergents, at four salinity levels on adult Tisbe bulbisetosa. The methylene method of anlysis was used to control stability of DBS over time. The effective concentration of DBS decreased within two weeks after preparation of solutions. This decrease seemed to be dependent on the initial concentration and the salinity level. The noxiousness of detergents decreased as salinity increased. The two-day LC50 of DBS in sea water with 36% salinity was 5.12 ppm. This is higher than expected, indicating that the other components of domestic detergents are toxic and that all the components together may have a synergistic effect. (Small-FRC)
W81-00889

EFFECT OF LEAD SPECIATION ON TOXICITY,
Clemson Univ., SC. Dept. of Zoology.
M. L. Freedman, P. M. Cunningham, J. E. Schindler, and M. J. Zimmerman.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 3, p 389-393, May-June, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Phosphates, *Speciation, *Lead, Metals, Hydrogen ion concentration, Bioassay, *Model studies, Cations, Chemical properties, Chemical reactions, *Toxicity, Limnology, Aquatic environment, Mathematical studies, Kinetics.

In limnological and aquatic toxicity studies the interactions between ligands and metals are often ignored. Tests were conducted to show the effects of phosphate on toxicity of lead in a synthetic medium. The REDEQL2 chemical equilibrium model was used to calculate lead speciation at different total concentrations of lead and phosphate and at pH 6 or 8. At pH 6, very little free lead was found to exist at high phosphate concentrations, regardless of total lead levels. Little free lead was predicted at any phosphate level at pH 8. Static bioassays on the amphipod, Hyallela azteca, were conducted to test the role of free lead versus total lead in causing toxicity. Graphs of mortality data for the maximum lead level (5 milligrams/liter) at three different phosphate levels show the detoxifying effect of increasing phosphate concentrations. Some physiological stresses due to the synthetic media, observed via control mortalities, explain slight deviations of observed results from predicted values at the highest (0.003 M) levels of phosphate tested. These findings demonstrate the value of chemical and kinetic equilibrium models in examining the interaction of extraneous substances which might affect results in aqueous systems. (Geiger-FRC)
W81-00902

PARAQUAT TOXICITY TO LOUISIANA CRAYFISH (PROCAMBARUS CLARKII),

Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
T-S. Leung, S. M. Naqvi, and N. Z. Naqvi.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 3, p 465-469, May-June, 1980. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Bioassays, *Mortality, *Crayfish, *Toxicity, *Mississippi River, *Paraquat, Lethal limits, Aquatic ecosystems, Rivers, Water pollution, Herbicides, Aquatic animals, Crustaceans, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Water pollution sources.

Paraquat is highly soluble in water and is used extensively in Louisiana to control all annual grassy and broadleaf weeds. If sufficient levels of the herbicide reach aquatic ecosystems, toxic effects on aquatic species might occur. The toxicity of paraquat to adult and juvenile Louisiana crayfish, an important human food, was examined in laboratory tests. Bioassays were conducted in Mississippi River Bayou water, with adult crayfish being exposed to 6 concentrations of paraquat (15-100 ppm) and juveniles to 5 levels of the herbicide (0.5-8.0 ppm). Dissolved oxygen, temperature, pH, and crayfish mortality were checked every 24 hours over the course of 96 hours. A significantly greater amount of oxygen was consumed by treated crayfish, in a dose-dependent and exposure time-dependent pattern. At 25 ppm, no mortality occurred in adults, while at only 8 ppm, 50% mortality was found for juvenile crayfish after 24 hours. The death rate increased with exposure time for both juveniles and adults. Juveniles proved more susceptible than adults to paraquat in the present study, and also to aldrin and mirex in other experiments reported in the literature. Adult crayfish also showed a dose-dependent hyperactivity with exposure to paraquat; this was not explained. (Geiger-FRC)
W81-00903

LEAD IN THE MARINE ENVIRONMENT,
M. Waldichuk.
Marine Pollution Bulletin, Vol 11, No 9, p 241-242, September, 1980.

Descriptors: *Lead, *Sea water, Toxicity, Analytical techniques, Regulation, Europe, Water analysis, Absorption, Water pollution, Heavy metals.

A general discussion is presented of lead, its toxicity, and research and monitoring efforts in marine environments. Reliable analyses of lead in sea water have been plagued with problems of contamination, interference, and high background levels. The California Institute of Technology has conducted some high quality analyses using the isotopic dilution technique with mass spectrometry. The Marine Biological Association of the United Kingdom in Plymouth has done some of the best work on lead uptake. New British regulations effective April 12, 1980 set specific limits for lead in fish (2 mg/kg) and shellfish (10 mg/kg). (Small-FRC)
W81-00904

AN APPARATUS FOR THE PREPARATION OF VARYING CONCENTRATIONS OF CHEMICALS FOR TOXICITY TESTS WITH AQUATIC ORGANISMS,
Natural Environment Research Council, (Bangor Wales). Marine Invertebrate Biology Unit.
A. R. Manley.
Water Research, Vol 14, No 8, p 1023-1027, August, 1980. 6 Fig, 6 Ref.

Descriptors: *Toxicity, *Water pollution, *Laboratory equipment, *Aquatic life, Monitoring, Testing, Aquatic environments, Research equipment, Automatic control, Model studies, Performance, Fluctuations, Simulation analysis, Discharge.

An increase in the chemical pollution of the aquatic environment has prompted the manufacture of an array of equipment to simulate chemical discharges for toxicity testing under a variety of environmental conditions. The apparatus described here is capable of producing planned variations in chemical levels for aquatic toxicity tests to allow more realistic study of naturally occurring variations and their effects on aquatic life. The apparatus was designed to produce chemical concentration gradients over short or extended time spans at high flow rates. The apparatus was also made from chemically inert material. The new device was equipped with an animal chamber, constant head tanks, uncontaminated water at a constant flow, a distilled deionized water stock tank, a mixing chamber, peristaltic pump, a chemical solution stock tank, Teflon tubing, an Ultrograd and an Ultrograd valve. Satisfactory levels of accuracy are achieved in chemical dosing with the apparatus under a variety of toxicity testing conditions. However, abrupt changes in the concentration of a pollutant still cause problems in the system resulting in about a 4.5 minute delay between actual and recorded concentrations. (Geiger-FRC)
W81-00919

RIPARIAN ECOSYSTEMS: A PRELIMINARY ASSESSMENT OF THEIR IMPORTANCE, STATUS, AND NEEDS.
Fish and Wildlife Service, Kearneyville, WV. Eastern Energy and Land Use Team.
Report, August 1980. 18 p, 64 Ref.

Descriptors: *Wildlife habitats, *Riparian land, *Ecosystems, *Floodplains, Water quality, Fish, Esthetics, Value, Land use, Land management, Economic justification, Conservation, Water quality, Wetlands, Environmental effects, Evaluation.

Riparian ecosystems have outstanding values for fish and wildlife, supporting very diverse and productive animal communities. A majority of the nation's wildlife, including a relatively large proportion of endangered species depend on riparian habitats for survival. In their natural condition floodplain ecosystems have tremendous intrinsic and potential values. Riparian systems function as a buffer between aquatic ecosystems and potential values. Riparian systems function as a buffer between aquatic ecosystems and potential impacts of upland activities upon water quality. Most riparian systems are jeopardized by intensive economic pressures for a variety of alternative land and water uses, including channelization, farming, flood control, grazing, hydroelectric projects, irrigation, water salvage efforts, and recreation. Consequently, 70 to 90% of all original riparian communities in the United States have already been destroyed. High fish and wildlife values, multiple intrinsic values and high economic values of natural riparian ecosystems argue for their protection and management. Extensive and continued loss of riparian habitat and associated fish and wildlife populations is testimony to the ineffectiveness of present conservation efforts. (Moore-SRC)
W81-00929

A MATHEMATICAL MODEL SIMULATING FISH LOSSES NEAR POWER PLANTS USING ROTENONE DATA,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
C. Kleinstreuer, and B. E. Logan.
Water Research, Vol 14, No 8, p 1047-1053, August, 1980. 7 Fig, 3 Tab, 33 Ref.

Descriptors: *Model studies, *Power plants, *Rotenone, *Fish populations, *Mortality, Toxicity, Lakes, Rivers, Aquatic ecosystems, Mathematical studies, Hydrodynamics, Temperature, Environmental effects, Future planning, Screens, Intakes.

Impingement studies at power plants have shown that cooling water intake screens have played a major role in fish loss and alterations in aquatic biota. The present study examines the main factors causing impingement, and attempts to develop an indicator to predict high impingement losses and which fish species will be affected. Far field estimates were used to gather data on flow patterns, temperature, and fish populations. Rotenone data was used specifically for estimating fish numbers because its application to the power plants was most consistent year after year. A method was devised to utilize rotenone samples to predict which fish species were the most likely to be impinged in greatest quantity based on their abundance in the fishery. The model was successfully applied to the Arkansas Nuclear One Plant (a lake with a long intake canal) and Brown's Ferry, Tennessee (a river with a short intake canal). The impingement model was also designed to be applicable to other sites for toxicity or fish mortality studies. It was proposed that the model along with the systems analysis approach be used in future planning in regard to optional location and design of power plant facilities. (Geiger-FRC)
W81-00933

STREAM CATION CONCENTRATIONS AND LOSSES FROM DRAINAGE BASINS WITH CONTRASTING LAND USES IN SOUTHERN ONTARIO,
York Univ., Toronto (Ontario). Dept. of Geography.
A. R. Hill.
Water Research, Vol 14, No 9, p 1295-1305, September, 1980. 5 Fig, 6 Tab, 18 Ref.

Descriptors: *Minerals, *Agricultural watersheds, Land management, Cations, Land use, Effects, Forest watersheds, Urban drainage, Ontario.

Factors affecting the concentration and loss of calcium, magnesium, potassium and sodium from 22 watersheds near Toronto, Ontario were investigated over a 27 month period. Human activities in agricultural and land use practices, soils, surface geology and topographic features were considered in relation to mineral and nutrient levels of the watersheds. Positive relationships were noted between calcium and potassium levels and crop area, while a negative correlation was observed between these cations and abandoned farm land plus forest and sand areas plus sandy loam soils. Multicolinearity was found between land use and soils, resulting in the association of soil properties and farming activities with stream cation levels. Lower annual stream discharges in agricultural watersheds than in watersheds surrounded by areas of forest and non-farm lands caused no correlations to appear between crop area and annual losses of calcium and potassium. Losses of potassium and sodium and stream levels of these cations were positively correlated with urban land use. Urban sampling regimes established that these areas are major supply wells for sodium and to a lesser extent, potassium, eventually found in streams. Variations in watershed hydrology had a major effect upon levels of magnesium, with little influence from urban or agricultural land use. (Geiger-FRC)
W81-00941

BIOACCUMULATION PROFILES OF 35S-LABELLED SODIUM ALKYLPOLY(OXYETHYLENE) SULFATES IN 35 CARP (CYPRINUS CARPIO),
Tokyo Metropolitan Research Inst. for Environmental Protection, Tokyo (Japan).
M. Kikuchi, M. Wakabayashi, H. Kojima, and T. Yoshida.
Water Research, Vol 14, No 10, p 1541-1548, October, 1980. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Toxicity, *Surfactants, *Carp, Aquatic life, Metabolism, Fish physiology, Water pollution effects, Laboratory tests, Environmental effects, Water pollution, Detergents, Water pollution sources.

Surfactants present as pollutants in the aquatic environment are often accumulated by aquatic organisms. The uptake, distribution and elimination of radioactively labelled sodium dodecyltri(oxyethylene)sulfate (C-12-AES 3) and sodium dodecylpenta(oxyethylene)sulfate (C-12-AES 5) were studied in carp (Cyprinus carpio). Carp were exposed to concentrations of 0.3-0.6 milligrams/liter of the compounds during the various experiments. Levels of detergents were measured by whole-body autoradiography and liquid scintillation counting. Rapid absorption of the compounds occurred via the gills and skin. After 24 hours of exposure, high levels of radioactivity were noted in gills, hepatopancreas, gall bladder, intestinal content and oral and nasal cavities. Similar distribution patterns for C-12-AES 3 and C-12-AES 5 were observed. Carp whole body concen-

tration factors after 72 hours of exposure were calculated to be 18 for C-12-AES 3 and 4.7 for C-12-AES 5. The absorbed radioactivity was eliminated more rapidly from fish exposed to C-12-AES 3 than to C-12-AES 5 in surfactant-free water, with elimination from the gills and hepatopancreas proceeding more rapidly than that from the gall bladder. (Geiger-FRC)
W81-00948

INFLUENCE OF WATER HARDNESS ON CADMIUM TOXICITY TO SALMO GAIRDNERI RICH,
Istituto di Ricerca sulle Acque, Milan (Italy).
D. Calamari, R. Marchetti, and G. Vailati.
Water Research, Vol 14, No 10, p 1421-1426, October, 1980. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Hardness, *Toxicity, *Rainbow trout, *Cadmium, Calcium, Heavy metals, Fish physiology, Water pollution, Laboratory tests, Lethal limits, Theoretical analysis, Chemical properties.

The effects of water hardness as well as the chemical species of metals on the acute toxicity of cadmium (Cd) to rainbow trout were examined in laboratory tests. The acute toxicity of Cd to trout was increased by reducing water hardness. The theoretical distribution of the chemical species of Cd in water of different levels of hardness at pH 7.2 was determined. Different levels of mortality were observed in fish exposed to similar concentrations of Cd in the same form. Different amounts of ionic-form Cd gave similar acute toxic effects. When fish acclimated at 320 milligrams CaCO3/liter were tested at 20 milligrams CaCO3/liter, an intermediate toxic effect was noted, showing agreement with the biological hypothesis. The proliferation of chloride cells in gills often accompanies exposure to toxic levels of metals. Fish exposed to hard water would normally contain a larger number of these cells, thereby making them more resistant to the toxic actions of Cd. Fish maintained in waters of a variety of hardnesses had different ionic contents in the blood, but the same number of chloride cells in the gills. Therefore detoxification schemes based mainly on the increase in chloride cells should be independent of hardness and show more relation to the presence of metals. However, some findings indicate the toxic action of Cd depends upon water hardness as a regulator of gill permeability. (Geiger-FRC)
W81-00949

AN APPROACH TO CHEMICAL AND BIOLOGICAL RIVER MONITORING SYSTEMS,
Southern Water Authority (England).
A. D. Hamer, and P. G. Soulsby.
Water Pollution Control, Vol 79, No 1, p 56-69, January, 1980. 5 Fig, 4 Tab, 30 Ref.

Descriptors: *Rivers, *Monitoring, *Reviews, *Water quality, *Bioindicators, *Water quality standards, Mathematical studies, Model studies, Water pollution control, Water pollution treatment, Sewage treatment, Fluctuations, Aquatic animals, Invertebrates, Biological communities, Water quality control, Diurnal, Streams.

New guidelines for the chemical and biological monitoring of river water are outlined to comply with quality objectives of the Water Act of 1973 and the Pollution Act of 1974. Chemical monitoring of a river is usually done to establish the long-term quality of the system, for pollution control and investigation, or for water quality monitoring. Quality monitoring should be done at frequent intervals; however, usually sampling is only done on a monthly basis. Mathematical evidence is presented to indicate the importance of obtaining an adequate number of samples to ensure accurate data. The effects that a particular discharge might have on the flora and fauna of the receiving stream are of particular importance in pollution investigations. The effects of diurnal fluctuations in effluent flows are considered in relation to sewage treatment works. Water quality modeling used a simple mass balance equation as a mathematical model. As yet, criteria have not been established for the biological surveillance of river water quality through the study of microinvertebrates. Problems of sampling and data analysis in biological monitoring are reviewed. Other data analysis techniques often used in biological studies include multivariate techniques, ordination, clustering, abundance categories, and community schemes. Taxa are characterized in an unpolluted Upper Chalk stream and an unpolluted tertiary stream to illustrate the application of principal component analysis, a multivariate technique, over a three year period. It was suggested that, regardless of costs, chemists as well as biologists take appropriate measures to gain the skills which will be needed for successful water quality monitoring in the future. (Geiger-FRC)
W81-00952

MICROBIAL DYNAMICS OF TWO SUB-ARCTIC CANADIAN RIVERS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright, K. V. Masuda, G. L. Ennis, and H. Schreier.
Water Research, Vol 14, No 9, p 1353-1362, September, 1980. 8 Fig, 6 Tab, 30 Ref.

Descriptors: *Rivers, *Sub-Arctic, *Aquatic productivity, *Microorganisms, Canada, Algae, Primary productivity, Ice breakup, Bacteria, Plankton, Standing crops.

Microalgal and bacterial biomasses and activities of two sub-Arctic rivers, Ogilvie and Swift Rivers, were greatest in spring and summer with decresing values noted through fall and winter. The data obtained suggests that light and dissolved organic carbon may be the major factors controlling standing crops and activities of microalgae and bacteria respectively. In late fall and winter, the phytoplankton and bacterioplankton were observed to be under greater physicochemical stress as compared to spring and summer. Microorganisms were more productive in the Ogilvie River than in the Swift River during all seasons. The authors suggest that the difference in productivity was due to the greater levels of total inorganic carbon and dissolved organic carbon found in the Ogilvie as compared to the Swift River at equivalent times of the year. (McKeon-FRC)
W81-00956

AVOIDANCE RESPONSE OF RAINBOW TROUT (SALMO GAIRDNERI) TO SINGLE-DOSE CHLORINATION IN A POWER PLANT DISCHARGE CANAL,
Wisconsin Electric Power Co., Milwaukee. Environmental Dept.
P. D. Schumacher, and J. J. Ney.
Water Research, Vol 14, No 6, p 651-655, June, 1980. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Toxicity, *Rainbow trout, *Chlorination, *Fish behavior, *Electric powerplants, *On-site tests, Canals, Lethal limits, Chlorine, Water pollution, Water treatment, Statistics, Distribution patterns, Analytical techniques, Lake Michigan, Effluents, Discharge, Thermal pollution, Water pollution sources, Aquatic animals.

The use of chlorination to control biofouling in stream electric plants may not affect aquatic life if avoidance responses to chlorine are practiced. The initial avoidance responses of rainbow trout (Salmo gairdneri) to single-dose chlorine additions in a power plant discharge canal were examined as a function of chlorine concentration and total exposure. Trout were exposed in a cooling water discharge canal of Wisconsin Electric Power Company's Lakeside Plant on Lake Michigan to chlorine additions designed to achieve maximum total residual chlorine (TRC) levels of 0.04, 0.2, 0.6, and 1.0 milligrams/liter. The first retreat of trout from the chlorine front was observed at 0.05 milligrams/liter TRC. About 95% of the trout moved downstream at 0.5 milligrams/liter TRC. Fish retreated from the exposure area well before cumulative time-dose exposure approached lethal limits. The decrease in percentage of fish near the discharge was linear with increasing TRC levels. It was suggested that complete evaluations of the use of the avoidance response must take into account trout distribution throughout chlorination and the chance for repeated exposures. (Geiger-FRC)
W81-00957

LONG-TERM EFFECTS OF PCB (CLOPHEN A50) ON GROWTH, REPRODUCTION AND SWIMMING PERFORMANCE IN THE MINNOW, PHOXINUS PHOXINUS,
National Swedish Environment Protection Board, Studsvik. Brackish Water Toxicology Lab.
B-E. Bengtsson.
Water Research, Vol 14, No 6, p 681-687, June, 1980. 4 Fig, 4 Tab, 31 Ref.

Descriptors: *Toxicity, *Fish behavior, *Minnows, *Fish reproduction, *Polychlorinated biphenyls, Pollutants, Water pollution, Fish toxins, Fish diets, Spawning, Laboratory tests, Fish physiology, Growth rates, Aquatic animals, Gas chromatography, Temperature, DDT, Chlorinated hydrocarbon pesticides, Pesticides.

The long-term sublethal effects of Clophen A50, a mixture of more than 50 polychlorinated biphenyl compounds (PCB), on the minnow (Phoxinus phoxinus) were examined in laboratory tests lasting 300 days. PCB's have been found as contaminants of many natural waters, and their toxicity to various aquatic organisms has been documented. In the present study, mortality, growth, swimming performance and reproduction were studied in minnows fed 20, 200 or 2000 micrograms PCB/g food (dry weight) for 40 days. Clophen A50 was found to promote the growth of minnows. Uptake of PCB residues varied between 22 and 36% upon gas chromatographic analysis of fish tissues. Mortality rate was very slow for all groups, but began to accelerate towards the end of the experiment. At the highest dose level, PCB delayed spawning and significantly reduced egg hatchability. Hatching times were significantly reduced in fish fed the medium and high doses of PCB. Effects of temperature upon hatchability and of egg formation and spawning on PCB body residues are also considered. No effects due to PCB were observed on swimming performance. (Geiger-FRC)
W81-00958

CONTAMINATION OF FRESH WATER AQUIFERS BY OIL SPILLS,
Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
For primary bibliographic entry see Field 5B.
W81-00963

CELLULAR BIOASSAY OF FISH AS A SENSITIVE INDEX OF WATER QUALITY RELATED TO MINE WATER,
West Virginia Univ., Morgantown. Water Research Inst.
D. E. Hinton, and E. R. Walker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-149742, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report, 1980. 139 p, 59 Fig, 9 Tab, 74 Ref. OWRT-A-037-WVA(1), 14-34-0001-0152.

Descriptors: *Acid mine water, *Water pollution effects, *Fish, *Bioassay, *Water quality, Analysis, Analytical techniques, Cytological studies, Coal mine wastes, Methodology, Mine water, Trace elements, Water quality standards, Chemical analysis, Evaluation, Metals.

The overall objective was to develop a cellular bioassay useful in determining the effects of constituents of mine water (acid, pH, and metals) upon tissues and enzymes of freshwater fishes and to determine, via biological criteria, water quality. Coal-associated polynuclear aromatics caused induction of drug metabolizing enzymes in fish. Mn(++) caused enhanced metabolism of benzo (a) pyrene in-vitro but was inhibitory under in-vivo conditions in rainbow trout. Particulate iron (Fe_2O_3) suspended in aquarium water and Mn(++) caused gill alterations. Most subtle changes involved swelling of surface epithelial cells (both metals) and appearance of phagocytic cells in secondary lamellae (Fe_2O_3). Mn(++) caused a reduction in the surface microridge pattern of gill epithelia. A quantitative morphometric

evaluation of control and acid-stressed (pH 4.0 or 5.0 by addition of H2SO4 to aquarium water) bullhead catfish showed a two-fold increase in the number of skin mucous cells of exposed fish, which was associated with an equivalent increase in volume density of skin mucosubstances. The three individual components of mine waters produced alterations which were easily differentiated from those produced by other agents and constitute evidence that cellular bioassay of target tissues in exposed fishes may yield valuable information relative to water quality.
W81-00980

ECOLOGICAL RESPONSE TO RELAXATION OF SEWAGE STRESS OFF SAN ISLAND, OAHU, HAWAII,
Hawaii Univ., Honolulu.
S. J. Dollar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-135436, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of Hawaii, Honolulu, Technical Report No 124, March, 1980. 84 p, 34 Fig, 2 Tab, 28 Ref, 2 Append. 14-34-0001-9013.

Descriptors: *Benthos, *Reefs, *Coral, *Ecology, Sewage effluents, *Hawaii, Speciation, Macrobenthos.

The largest domestic sewage outfall in Hawaii discharged 3 cu m/s (62 mgd) of raw sewage in 10 m of water approximately 1,000 m off Sand Island, Oahu, from 1955 to 1977. Results of an ecological field study of epibenthic communities in proximity to Sand Island conducted in 1975 and 1979 show clear patterns of community change associated with both sewage impact and relaxation of this stress; negative community effects attributable to sewage input decreased, and degree of recovery of community structure increased with distance from the point source of discharge. Sewage discharge had an impact of up to 5,000 m west and 1,900 m east of the outfall. This elliptical area of influence is assymetrical to the west due to the prevailing current pattern which carried the sewage-laden plume to the southwest. Following sewage abatement two distinct zones of impact are distinguished by the degree of physical degradation of the benthic reef structure. A high impact zone extending some 500 m east and 1,000 m west of the outfall is now characterized by a complete biochemical reduction of the reef structure to a pitted, flat carbonate pavement covered presently with sediment-bound algal turf and few benthic faunal colonizers. In the zone of intermediate impact the old reef framework is largely intact, though devoid of most living corals. Instead a veneer of encrusting coralline algae covers most of the reef framework. Patterns of occurrence and diversity of reef fish show characteristics of response to sewage stress similar to attached invertebrates except that the area of influence is of much smaller extent. (Author's abstract)
W81-00983

ROLE OF SEAGRASSES IN ESTUARINE SYSTEMS,
Seattle Pacific Univ., WA. School of Natural and Mathematical Sciences.
R. C. Phillips.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 67-96. 1 Tab, 126 Ref, 1 Append. OCE 74-24358 A01.

Descriptors: *Marine plants, *Estuarine environment, *Seagrasses, *Ecology, Ecosystems, Water pollution effects, Salinity, Water temperature, Primary productivity, Cycling nutrients, Dredging, Aquatic animals, Eutrophication, Depth.

Owing to the protection from erosion they provide, their role in sediment accretion, and their high primary productivity, seagrasses are extremely important to coastal ecosystems. Estuaries typically support large seagrass meadows, and 80 to 90% of commercial and sport fishes depend on estuaries for part or all of their life cycle. Seagrasses appear to be euryhaline, with various species growing in waters of 6 to 60 parts per thousand salinity, and they tolerate a wide range of water temperatures. The depth distribution of seagrasses depends on interrelated factors: waves, currents, substrate, turbidity, and light penetration. Productivity, role in the food chain, nutrient cycling, and sediment stabilization are important ecological functions of seagrass meadows. Dredging poses the greatest threat to the seagrass ecosystem. Other hazards to seagrasses include eutrophication, temperature and salinity changes due to man's activities, wind and sea stress, population explosions, oil pollution, heavy metal pollution, and dumping of other toxic substances. Techniques for measuring the productivity of seagrasses are described in the appendix. (Moore-SRC)
W81-00995

ECOLOGY OF A HYPERSALINE LAGOON: THE LAGUNA MADRE,
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
W. Pulich, Jr.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 103-122. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Estuarine environment, *Saline water, *Cycling nutrients, *Lagoons, *Ecology, Texas, Salinity, Marine plants, Detritus, Marine algae, Light penetration, Productivity, Water pollution, Seagrasses, Laguna Madre(TX).

A coastal Gulf of Mexico ecosystem, the Texas Laguna Madre represents one of only three oceanic hypersaline lagoons in the World. Salinity fluctuations between 30 and 60 per thousand now constitute a major feature of Laguna Madre. The overriding influence of salinity makes the Upper Laguna too unstable for biological succession, and consequently colonizing species persist. The Lower Laguna has showed shifts in species abundance in recent years. Environmental constraints have led to the dominance of three monotypic plant habitats: seagrass beds, algal mat communities, and drifting seaweeds. While the species distribution of benthic plants in the Laguna Madre is attributable to the general salinity conditions, the abundance of seagrasses in the Upper Laguna may be traced to the water clarity and nutrient loading effects. The combination of low nutrient input, but high primary and secondary production of the Upper Laguna indicates the efficiency of the nutrient cycling process there. Any activity which opens the system to flushing would cause significant impact on cycling of nutrients from detritus. The accumulation of pollutants in the Laguna also presents a real threat to sustained productivity. Pollutants such as pesticides and metals, drained from Rio Grande Valley agricultural and residential areas certainly are changing the Lower Laguna today. (Moore-SRC)
W81-00997

MANAGING IMPACTS OF PETROLEUM DEVELOPMENT IN BRACKISH MARSHES,
General Land Office of Texas, Austin.
W. Longley, and R. G. Jackson.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 157-174. 12 Ref.

Descriptors: *Oil fields, *Brackish water, *Coastal marshes, *Environmental effects, *Management, Exploration, Natural gas, Wetlands, Marsh management, Flow, Ecosystems, Hydrology, Canals, Levees, Roads, Construction, Texas, Blaumont area(TX).

Petroleum exploration and extraction operations produce two obvious levels of ecological effects in marsh ecosystems. The first level involves the radical change or complete removal of a given parcel of the system. Unrestrained growth and development of an oil field maximizes habitat fragmentation, which can radically alter the ecological character of the ecosystem. The second level of effects occurs when threshold levels of critical linkages or components are reached, and the ecosystem changes noticeably. Water is the major factor in maintaining marsh systems. Brackish marshes and delta marshes characteristically receive inputs of both saline and fresh water, although not in equal proportions. The movement of water through the system is the important force driving and controlling the wetlands. Because roads, levees, and canals alter water flows, they are considered to be the source of the most important impacts at the ecosystem level. Methods of reducing significant impacts from oil and gas operations can be catergorized as: minimizing total habitat losses during each phase of petroleum activities; maintaining adequate major water flows for the particular wetland ecosystem; and providing for restoration of landforms and conditions after petroleum operations have terminated. (Moore-SRC)
W81-00998

5D. Waste Treatment Processes

OPTIMAL PERIODIC CONTROL OF ACTIVATED SLUDGE PROCESSES: II. COMPARISON WITH CONVENTIONAL CONTROL FOR STRUCTURED SLUDGE KINETICS,
Houston Univ., TX. Dept. of Chemical Petroleum Engineering.
S. Y. S. Yeung, D. Sincic, and J. E. Bailey.
Water Research, Vol 14, No 1, p 77-83, January, 1980. 5 Fig, 2 Tab, 8 Ref, 1 Append.

Descriptors: *Waste water treatment, *Activated sludge, *Mathematical models, *Automatic control, Kinetics, Biochemical oxygen demand, Flocculation, Microbial degradation, Organic loading, Design.

Optimal periodic control and conventional control of activated sludge are compared by means of mathematical models. Conventional control was defined as a steady-state base case design augmented by a regulating controller of a kind typically used for the activated sludge process. For two quite different examples, periodic control reduced effluent BOD and/or its variability relative to conventional control. The optimal periodic control for structured sludge kinetics can be substantially different from the Monod/decay result. This result has important implications. If minimization of effluent BOD is the objective, classical control may produce control manipulations that are nearly opposite to the most effective response. Since the structured kinetics are believed more accurately to reflect the true behavior of the system, use of Monod/decay kinetics must be viewed with caution in designing conventional or optimal periodic dynamic operational strategies. Since the structured model may behave approximately like the Monod model or much differently, depending upon its parameter values, accurate kinetic parameter identification for a particular process is important in designing operational approaches. (McKeon-FRC)
W81-00769

THE TREATMENT OF MALT WHISKEY DISTILLERY WASTE USING THE FUNGUS GEOTRICHUM CANDIDUM,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
J. P. Quinn, and R. Marchant.
Water Research, Vol 14, No 5, p 545-551, May, 1980. 3 Fig, 6 Tab, 23 Ref.

Descriptors: *Waste water treatment, *Fungi, *Cultures, *Biochemical oxygen demand, *Chemical oxygen demand, Carbon, Economic feasibility, Biomass, Proteins, Organic wastes, Industrial wastes, Whiskey distillery waste, Malt.

The effects of the imperfect fungus Geotrichum candidum in reducing the BOD, COD, and total organic carbon (TOC) of Irish malt whiskey distill-

ery waste are reported. When the fungus was grown in batch and in single and tow-stage continuous laboratory culture, a maximum BOD reduction of 92.2% was achieved. Maximum reductions of 80.6% and 75.6% were achieved for COD and TOC, respectively. When a two-stage continuous culture system was used, the fungal biomass removed from the second fermenter, when operated at a dilution rate of 0.125/hr, was found to have a true protein content of 45.5%. The economic prospects of using this process for waste treatment and perhaps as a source of single-cell protein seem encouraging. (McKeon-FRC)
W81-00772

DENITRIFICATION WITH METHANOL: MICROBIOLOGY AND BIOCHEMISTRY,
Natal Univ., Peitermaritzburg (South Africa). Dept. of Biochemistry.
G. R. Nurse.
Water Research, Vol 14, No 5, p 531-537, May, 1980. 5 Fig, 56 Ref.

Descriptors: *Water treatment, *Denitrification, *Mathematical models, Microbiology , Chemical reactions, Anaerobic bacteria, Nitrates, Activated sludge, Carbon, Biomass, Equations.

The development of a theoretical equation that adequately describes the stoichiometry of the denitrification of nitrate-polluted effluents with methanol is presented. Kinetic parameters previously reported have been for an unidentified biomass, as it was believed that the composition of bacterial species present in reactors was unimportant. However, denitrification with methanol results in selective enrichment of the genus Hyphomicrobium. Nitrate assimilation and respiration in inorganic nitrogen metabolism, methanol oxidation, and methanol assimilation are discussed. To develop the desired equation, the amounts of methanol and nitrate required to supply the total energy and reducing power requirements for the biosynthesis of cell material were determined. The energy requirement for 3-phosphoglycerate (3-PGA) and energy and reducing power requirements for synthesis of cells form 3-PGA with nitrate as nitrogen source and for synthesis of cells from methanol and nitrate were calculated as equations. From these, the equation 50.5 CH3H + 3 HN3 + 46.2 N3(-) yields 3 C4H72N + 38.5 C2 + 23.1 N2 + 46.2 H(-) + 68.9 H2 is derived. When the equation was used to calculate a theoretical growth yield (0.188 g cells/g methanol on an ash-free basis) or a consumptive ratio (1.31), the values obtained closely agreed with experimental values. This corresponds to experimental values of 0.195 g cells/g methanol with an ash content of 3.7% and a consumptive ratio of 1.30 plus or minus 0.06. The development of an equation describing the upper limit to the yield parameter is important for optimizing.
W81-00774

ESTIMATION OF NITRIFYING BIOMASS AND KINETICS IN WASTEWATER,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
E. R. Hall, and K. L. Murphy.
Water Research, Vol 14, No 4, p 297-304, April, 1980. 6 Fig, 4 Tab, 31 Ref.

Descriptors: *Waste water treatment, *Nitrification, *Microorganisms, *Nitrates, Nitrites, Kinetics, Bacteria, Oxidation, Tertiary treatment, Biomass.

A technique for in situ measurement of nitrogen oxidation rates in waste waters is described. An estimate of the nitrifying populations and their maximum specific substrate rates in the presence of heterotrophic organisms can be made by the direct addition of known quantities of pure nitrifiers to a mixed liquor sample, along with selective inhibition of Nitrosomonas activity. The design and modeling of combined carbon removal-nitrification systems for steady and dynamic loading conditions is made possible by knowledge of these parameters. Nitrogen oxidation was shown to be zero order for substrate and first order for microorganism concentration. Populations of nitrifiers in mixed liquor increased significantly with total Kjeldahl nitrogen loading. In addition, substantial changes were noted in maximum unit oxidation rates. This suggested a differential effect of heterotrophic organisms on nitrifying bacteria. (McKeon-FRC)
W81-00780

SIGNIFICANCE OF COD, BOD AND TOC CORRELATIONS IN KINETIC MODELS OF BIOLOGICAL OXIDATION,
West Pakistan Univ. of Engineering and Technology, Lahore.
J. A. Aziz, and T. H. Y. Tebbutt.
Water Research, Vol 14, No 4, p 319-324, April, 1980. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Biochemical oxygen demand, *Chemical oxygen demand, *Waste water treatment, *Organic loading, Correlation analysis, Model studies, Organic compounds, Biological treatment, Activated sludge, Oxidation, Mathematical studies, Kinetics, Sewage effluents, Domestic wastes.

At the Birmingham University, England, pilot plant for treating domestic sewage by activated sludge, correlations between COD, BOD, and total organic carbon (TOC) were analyzed at various stages of waste treatment. Automatic hourly collections were made over a 24-hr period from the influent to the aeration tanks and from the effluents from the final clarifiers. A significant correlation was found between COD and BOD for settled domestic sewage ($r = 0.747$, $p < 0.05$). As biological treatment proceeded, COD:BOD ratios of treated effluents increased, and no conclusively significant correlation between the parameters was found. BOD:TOC ratios decreased during treatment and were not significantly correlated in any filtered or unfiltered samples. Similarly, TOC was not satisfactorily related to COD. Studies of biological oxidation kinetic models revealed that these polluted assessment parameters are not interchangeable unless changes are made in the mathematical constants. Therefore, the indiscriminate interchanging of BOD, COD, and TOC in biological oxidation studies is not advisable. (Geiger-FRC)
W81-00784

AN EVALUATION OF PRETREATED NATURAL ZEOLITES FOR AMMONIUM REMOVAL,
Monsanto Research Corp., Dayton, OH. Dayton Lab.
J. R. Klieve, and M. J. Semmens.
Water Research, Vol 14, No 2, p 161-168, February, 1980. 1 Fig, 9 Tab, 22 Ref.

Descriptors: *Zeolites, *Ammonium, Water treatment, *Waste water treatment, Analytical techniques, X-ray diffraction, *Tertiary treatment, *Nutrient removal, Nitrogen compounds, Acids.

The results of laboratory studies on the evaluation of phillipsite, mordenite, erionite, and pretreated clinoptilolites for ammonium removal from wastewater are presented. Clinoptilolite's capacity for NH4(+) was not significantly affected by heat treatment (600C for 1 hr), but the zeolites capacity for NH4-N in the presence of competing cations was increased. The selectivity of clinoptilolite for ammonium was thus enchanced. Upon treating clinoptilolite with NaOH, its capacity for NH4-N using a pure solution of NH4Cl as feed was slightly improved, but the zeolite's selective capacity for NH4-N in the presence of competing cations was not affected. Acid (HNO3) and steam treatments did not influence clinoptilolite's capacity for NH4-N. Phillipsite's observed selectivity for ammonium was equal to clinoptilolite's, and its higher total capacity resulted in an effective capacity that was about double that of clinoptilolite on a weight basis. Unfortunately, phillipsite is structurally weak and breaks easily to produce fines, and it is about twice as expensive as clinoptilolite. If the strength of phillipsite could be improved with a binder it may become useful for water treatment. Erionite and mordenite removed ammonium poorly. (McKeon-FRC)
W81-00790

SOME DIMENSIONLESS PARAMETERS OF IMPELLER POWER IN COAGULATION-FLOCCULATION PROCESSES,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
J. Leentvaar, and T. S. J. Ywema.
Water Research, Vol 14, No 2, p 135-140, February, 1980. 8 Fig, 3 Tab, 12 Ref.

Descriptors: *Waste water treatment, *Flocculation, *Coagulation, *Impellers, Colloids, Reynolds number, Pilot plant, Mixing, Treatment facilities, Mathematical studies, Domestic wastes, Velocity.

The effect of impeller and vessel geometry on impeller power dissipation was discussed. Particular attention was paid to square tanks as commonly used in coagulation-flocculation processes of waste waters. A pilot-scale dynamometer was used to measure dissipated energy into the water by the impeller as a function of revolutions/min. Four stirrers were used: a paddle, a small and a large two bladed propeller, and a turbine stirrer. The experiments showed that the dimensionless Power number for a square tank can be estimated by the Power number of a baffled cylindrical tank with distance between two baffles equal to the diameter of the square tank. The experiments showed a direct ratio between G value (average velocity gradient of the fluid) and another dimensionless number, the Reynolds number. When the dimensionless Power number was plotted as a function of the Reynold number on a log-log scale, it was found that at Reynolds numbers > 1,000, the dimensionless power number was constant for the square and cylindrical baffled tanks. Coagulation-flocculation experiments with mainly domestic sewage of the village of Bennekom indicated that the coagulation-flocculation performance for the removal of colloidal compounds at the same G value differed slightly with the stirrer type and type of vessel applied. The optimal G value was the same for all vessel-stirrer combinations. (McKeon-FRC)
W81-00791

UTILISATION, TREATMENT AND DISPOSAL OF DISTILLERY WASTEWATER,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
G. J. Sheehan, and P. F. Greenfield.
Water Research, Vol 14, No 3, p 157-277, March, 1980. 1 Fig, 9 Tab, 150 Ref.

Descriptors: Reviews, *Waste water treatment, Fertilizers, *Fermentation, Yeasts, *Alcohols, *Filtration, Biological treatment, Recycling, *Waste water disposal, Biomass, Nitrification, Denitrification, Sewage lagoons, Anaerobic digestion, Sludge treatment, Waste treatment, Activated sludge, Cultures, Trickling filters, Byproducts, Municipal wastes, Profit, Costs, Agriculture, Irrigation programs, Deep wells, Aquatic ecosystems, Toxicity, Environmental effects, Sewage effluents, *Distillery waste water.

Methods used in the treatment of distillery wastewater are reviewed. Distillery wastewater is usualiy comprised of a high volume of greatly acidic matter which presents many disposal and treatment problems. Waste streams generally contain high levels of both dissolved organic and inorganic materials. There has been increasing interest in the use of ethanol from biomass as a liquid fuel alternative. Ethanol fermentation is examined in relation to distillery wastes. Reducing the volume of wastes may be accomplished by fermenting higher strengths of molasses. Raw stillage discharge has a highly deleterious effect on fish life. Stillage has been proposed for use as a fertilizer, food supplement, biomass production agent, animal feed, and potash source. Physical-chemical treatment of stillage has met with little success. Anaerobic digestion, anaerobic filters, lagoons, activated sludge, trickling filters and rotating biological contactors have all been successfully applied to the treatment of stillage waste water. Pilot and full scale data is also available on the combined treatment of municipal wastes and stillage wastes. NaNO3 addition to stillage in shallow lagoons, followed by denitrification, has also been tried. (Geiger-FRC)

W81-00796

INVESTIGATION TO REPLACE THE CONVENTIONAL SEDIMENTATION TANK BY A MICROSTRAINER IN THE ROTATING DISC SYSTEM,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau and Wasserguetewirtschaft.
P-S. Cheung, K. Krauth, and M. Roth.
Water Research, Vol 14, No 1, p 67-75, January, 1980. 7 Fig, 6 Tab, 16 Ref.

Descriptors: *Waste water treatment, *Microstrainers, *Settling basins, *Suspended solids, Biological treatment, Filters, Rotating disc system, Effluents, Weather, Separation techniques, Tertiary treatment.

The efficiency of a microstrainer to remove suspended solids (SS) from the effluent of a rotating disc system was studied. The microstrainer (filter medium: polyester fiber fabric; filter surface area: 1.17 sq m) and a conventional sedimentation tank (surface area: 64 sq m) were run in parallel to compare the removal rates of each. Under dry weather flow conditions, the microstrainer removed about 95% of SS, achieving an effluent with about 8 mg/liter SS at a surface loading rate of up to 20 m/hr. The ability of the microstrainer to remove SS under wet weather flow conditions was slightly lower but still fell within acceptable limits. The microstrainer failed to effectively remove SS from the effluent of a partially treated biological system. Direct comparison between the efficiency of the microstrainer and of the conventional sedimentation tank showed that it was justified for the former to replace the latter in a rotating disc system with complete biological treatment. (McKeon-FRC)
W81-00797

STANDING PROUD. CONSISTENCY SPELLS SUCCESS AT SALT CREEK,
Salt Creek Drainage Basin Sanitary Dept., Villa Park, IL.
F. Dole, and J. Crosby.
Water and Sewage Works, Vol 127, No 10, p 18, 49, October, 1980. 2 Fig, 2 Ref.

Descriptors: *Treatment facilities, *Waste water treatment, *Sludge treatment, *Anaerobic digestion, Sludge, Dewatering, Drying, Aeration, Separation techniques, Sand, Filtration.

The wastewater treatment plant at Salt Creek, Illinois, is described. The plant effluent averages 1.48 mg/liter suspended solids and 1.79 mg/liter BOD, according to 1979 records. The activated sludge plant treats an average flow of 3 mgd. About 90% of the flow is domestic in nature. Raw sludge is pumped into one or two primary anaerobic digesters once or twice daily. For drying and dewatering there are 12 sand drying beds available and a belt filter press. An average of 25,000 gal/wk of sludge is pumped from the secondary digester to the sand drying beds or the belt filter press. At least an equivalent amount of supernatant is produced. Good liquid-solid separation is achieved in the secondary anaerobic digesters. Liquid drawn from secondary digesters is returned directly to the preaeration tanks, with the effluent going directly into the primary clarifiers. The return is at the rate of about 20 gpm. The supernatant is aerated with 2-3 ppm dissolved oxygen upon returning it to the primary treatment units. Close monitoring of raw sludge pumping, consistent temperatures throughout primary digesters, and consistent sludge drawoffs from the secondary digesters have produced the well-digested sludge reported at this plant. (Baker-FRC)
W81-00799

ROTATING DISC SEWAGE TREATMENT SYSTEM FOR SUBURBAN DEVELOPMENTS AND HIGH-DENSITY RESORTS OF HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
G. T. Griffith, R. H. F. Young, and M. J. Chun.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-138349, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, Technical Report No 116, May, 1978. 72 p, 22 Fig, 19 Tab, 43 Ref, 1 Append. OWRT-A-068-HI(2), 14-34-0001-7025.

Descriptors: *Sewage treatment, *Suburban areas, *Municipal wastes, *Hawaii, *Design criteria, Treatment, Waste treatment, Research and Development, Potential flow, Suspended solids, Wastes, Biochemical oxygen demand, Waste water(Pollution), Water Quality control, Water quality, Sewage systems, Sewerage, Sewage sludge.

Testing of this large-scale pilot rotating disc treatment system was carried out at the Honolulu Pacific Palisades Municipal Wastewater Treatment Facility to determine its treatment effectiveness and to provide design/operation criteria in domestic waste water treatment in Hawaiian/tropical climates. The system included primary clarification and sludge storage facilities, and a 1.8-foot disc diameter 225 sq ft four-stage rotating disc treatment unit. The test unit, evaluated at four hydraulic loadings (2.25-6.7) gallons per day per sq ft, achieved overall removal of carbonaceous BOD-5 and suspended solids of 94-82 and 96-82% when treating degritted raw domestic waste water. Peripheral rotational disc speed was held constant (1.0 foot per second) and waste water temperature of 27-28 degrees was used for the study. The disc section produced 0.40-0.50 mass units sludge per mass unit BOD-5 removed in the disc section. Installed rotating disc package systems treating sewage volumes of 25,000 and 100,000 gallons per day were estimated to be about 10% higher than for extended aeration and high-rate activated sludge package systems, but total annual cost over a 20-year period would be about 14 and 20% lower than these systems, respectively. (Zielinski-IPA)
W81-00801

INFLUENCE OF FULVIC ACID ON THE REMOVAL OF TRACE CONCENTRATIONS OF CADMIUM(II), COPPER(II), AND ZINC(II) FROM WATER BY ALUM COAGULATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt, and J. H. Weber.
Water Research, Vol 13, p 1171 to 1177, 1979. 4 Tab, 33 Ref, OWRT-B-004-NH(5), 14-34-0001-8132.

Descriptors: Copper, Cadmium, Zinc, *Fulvic acid, *Water treatment, Ions, Water pollution, *Trace elements, *Coagulation, Separation techniques, Trace metals, *Alum coagulation, Metal ion removal, Coagulants.

The effectiveness of Cu sup 2+, Cd sup 2+ and Zn sup 2+ removal form solution by alum coagulation was measured with fulvic acid present and absent. A factorial experimental design and analysis of variance were used to determine the effect on metal ion removal of the individual variables pH, metal ion concentration, alum concentration and fulvic acid concentration and their combinations. The variable levels model water treatment plant conditions. Metal ion losses up to 96% for Cu sup 2+, 59% for Cd sup 2+ and 82% for Zn sup 2+ were measured in the preence of fulvic acid. In its absence the maximum metal ion losses observed were 93%, 14% and 53% for Cu sup 2+, Cd sup 2+ and Zn sup 2+, respectively. Fulvic acid enhances metal ion removal under most experimental conditions. The practical implication of the results is that strong complexes between natural water organic matter and metal ions enhance their removal by the alum coagulation process.
W81-00807

A FEW THOUGHTS ON WASTE,
National Building Research Inst., Pretoria (South Africa).
R. C. Jones.
The Certified Engineer (Johannesburg), Vol 52, No 3, p 382-386, March, 1979.

Descriptors: *Pollution abatement, *Waste disposal, *Management, *Optimization, *Social aspects, Technology, Methodology, Soil conservation, Waste dumps, Waste treatment, Water conservation, Water consumption, Water pollution control, Energy, Recycling, Rainfall, Desalination, Winds, Tides, Hydrogen, Hydroelectric power, Stream, Animal population, Vegetation, South Africa.

A challenge is presented to every one to decrease waste, recycle material, use what materials are available wisely and conserve what we have. A decrease in waste is economically feasible if it is applied correctly such as where refuse from one plant's operation is used as the raw material for another. Water recycling and conservation is particularly critical in South Africa because consumption will surpass the amount of rainfall by 1986. More water can be obtained by desalination of seawater and purification of effluent water by plants such as the water hyacinth. The nutrients in the soil must be maintained and the amount of gaseous wastes decreased in the air. New and old sources of energy must be found and rediscovered such as hydrogen, hydroelectric power, stream, sunlight, wind, tides, and lightening. Indigenous animal populations which are good protein producers should be fully exploited. The potential for human ingenuity and talent development remains the key to responsible waste management and a productive society. (Sidney-IPA)
W81-00812

PERFORMANCE OF AEROBIC DIGESTION AT DIFFERENT SLUDGE SOLID LEVELS AND OPERATION PATTERNS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. Ganczarczyk, M. F. Hamoda, and H-L. Wong.
Water Research, Vol 14, No 6, p 627-633, June, 1980. 9 Fig, 3 Tab, 18 Ref.

Descriptors: *Activated sludge, *Suspended solids, *Laboratory tests, *Sludge digestion, Aerobic digestion, Volatility, Sewage treatment, Continuous flow, Biological treatment, Operations, Waste water treatment, Degradation, Sludge treatment.

Laboratory batch and semi-continuous experiments were conducted to clarify the relationship between the digestion performance and the level of solids in the aerobic digestion process, to study the operation patterns of aerobic digestion, and to compare the effectiveness of aerobic digestion of both the primary sewage sludge and the waste (excess) activated sludge. Aerobic digestion of primary sludges and waste secondary activated sludges was carried out at 20 degrees with solids concentrations of 60,000 milligrams/liter and 20,000 milligrams/liter, respectively. Results showed that aerobic digestion of more concentrated sludges was associated with slower solids degradation rates. However, in the range of concentrations tested, the more concentrated sludges yielded greater masses of volatile suspended solids decomposed per unit digester volume per day. The amounts of volatile suspended solids decomposed per unit digester volume per day were similar for the primary and secondary sludges with the same volatile suspended solids concentration. Results of batch digestion tests were not directly applicable to the design of continuous flow aerobic digesters. It was also found that sludge treatment by a higher level of solids could be used to obtain a more stabilized sludge product. (Geiger-FRC)
W81-00865

FLOC-FORMING SUBSTANCES EXTRACTED FROM ACTIVATED SLUDGE BY SODIUM HYDROXIDE SOLUTION,
Gifu Coll. of Pharmacy (Japan). Dept. of Environmental Hygiene.
T. Sato, and Y. Ose.
Water Research, Vol 14, No 4, p 333 to 338, April, 1980. 1 Fig, 5 Tab, 37 Ref.

Descriptors: *Activated sludge, *Sewage bacteria, *Flocculation, *Separation techniques, *Chemical analysis, Proteins, Carbohydrates, Metals, Hydrogen ion concentration, Spectrophotometry, Analytical techniques, Sodium hydroxide, Slime, Viscosity, Gas chromatography, E. coli.

The viscous substance which has been implicated as the cause of floc formation in activated sludge

and is produced by sludge bacteria was extracted from activated sludge with 2 N and 0.1 N NaOH solutions by a modified method of Tezuka. The resultant NaOH extracts flocculated kaolin and E. coli suspensions at pH values below 3. Substances extracted from E. coli with 2 N NaOH solution did not flocculate the suspensions of kaolin in any pH range. The 2 N NaOH extract yielded 4.55%, while the 0.1 N Na0H extract yielded 1.12% of viscous substance. The chemical compositions of these extracts were determined after elemental and gas chromatographic analyses and tests for protein, carbohydrates, RNA, DNA, and sugars. Paper chromatography, color reactions of uronic acid, and determinations of metals in the ash by atomic absorption emission spectrophotometry were also carried out. Results showed that extracts contained protein, carbohydrates, nucleic acids and ash. The carbohydrate components contained the sugars arabinose, mannose, galactose, glucose, amino sugar and a few other sugars. Among the 11 metals found in the sludge extracts, Na, Fe, Ca, and K were present in larger amounts. (Geiger-FRC)
W81-00869

STUDIES ON THE USE OF INORGANIC GELS IN THE REMOVAL OF HEAVY METALS,
Roorkee Univ. (India). Dept. of Chemistry.
S. K. Srivastava, G. Bhattacharjee, A. K. Sharma, and C. K. Oberoi.
Water Research, Vol 14, No 2, p 113-115, February, 1980. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Waste water treatment, *Heavy metals, *Gels, Separation techniques, Ion exchange, Sorption, Iron, Cobalt, Zinc, Silver, Cadmium, Mercury, Thallium, Inorganic compounds.

Investigations are reported on the sorption and recovery of some heavy metal ions on columns using inorganic gels as exchanger material. Chromium ferrocyanide gel demonstrated a great affinity for Ag, Cu, Tl, Zn, Co, Cd, Mn, and Fe ions. The only drawback seen to using this type of column is the limited recovery of only a few metal ions such as cobalt, cadmium, manganese, zinc and lead. Silver and copper are irreversibly taken up. Even so, the method can be used to separate these metal ions from waste water in the presence of other salts and high acidity. (Baker-FRC)
W81-00872

FULL-SCALE PHYSICAL-CHEMICAL-BIOLOGICAL TREATMENT OF TEXTILE WASTEWATERS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall, and P. H. King.
Progress in Water Technology, Vol 12, No 3, p 231-238, 1980. 4 Fig, 4 Tab.

Descriptors: *Biological treatment, *Aeration, *Industrial wastes, *Textiles, Waste water treatment, Chemical oxygen demand, Biochemical oxygen demand, Suspended solids, Color, Sludge, Water purification, Water pollution, Organic compounds, Aeration lagoons.

The treatment of textile wastewaters by three full-scale plants was compared. Plant A was the simplest of the three plants; it consisted of only an extended activated sludge system plus sand drying beds. Plants B and C both had biological and chemical processes, with plant B placing the chemical system first and plant C placing the biological system first. Results showed that biological processes alone produced an inferior quality effluent in terms of organic matter, suspended solids, color, and total phosphorus. The best effluent in terms of biochemical oxygen demand (BOD) and total suspended solids (TSS) was plant C; however, plant B had a lower chemical oxygen demand (COD) and a lower color. Most of the BOD, but less than half of the COD and color were removed by the biological treatment of planct C. In plant B, less than 20% of the COD but over 90% of the color was removed by the biological processes. Both plants B and C had biological processes which increased the TSS. Plant B proved to be the most trouble-free operation, while plant C effected the highest removals of all wastewater constituents. (Geiger-FRC)
W81-00873

THE EFFECT OF PLANT CONFIGURATION ON SLUDGE BULKING,
Water Pollution Research Lab., Stevenage (England).
M. J. D. White, E. J. Tomlinson, and B. Chambers.
Progress in Water Technology, Vol 12, No 3, p 183-188, 1980. 4 Fig, 6 Ref.

Descriptors: *Activated sludge, *Settling velocity, *Mixing, Pilot plants, Aeration, Biological treatment, Dispersion, Kinetics, Model studies, Sedimentation, Microorganisms.

Many different factors control the performance of an activated sludge system. Two aspects of process design which may be employed to improve the settling properties of activated sludge, anoxic mixing and longitudinal mixing, were investigated in pilot studies and full-scale activated sludge aeration tanks. The incorporation of an anoxic mixing stage into the aeration tanks of conventional nitrifying activated sludge plants caused improvements in sludge settlability, which were attributed to a reduction in longitudinal mixing as well as the introduction of an anoxic environment. Chemical and radioactive tracer studies have shown that the degree of longitudinal mixing could be expressed as a dimensionless Dispersion Number. A correlation was noted between the Dispersion Number and the settling characteristics of the activated sludge, which was expressed as the Stirred Specific Volume Index. Sludges with better settling properties were produced by aeration tanks with lower Dispersion Numbers, because in tanks with higher Disperion Numbers, conditions of complete mixing were simulated. (Geirger-FRC)
W81-00874

FLOC SIZE, FILAMENT LENGTH AND SETTLING PROPERTIES OF PROTOTYPE ACTIVATED SLUDGE PLANTS,
Georgia Inst. of Tech., Atlanta, GA.
M. Sezgin, D. Jenkins, and J. C. Palm.
Progress in Water Technology, Vol 12, No 3, p 171-182, 1980. 5 Fig, 6 Tab, 7 Ref.

Descriptors: *Flocculation, *Activated sludge, *Model studies, *Settling velocity, Prototype tests, Microorganisms, Sewage bacteria, Biological treatment, Theoretical analysis, Laboratory tests, Waste water treatment, Sewage treatment.

The applicability of the relationship between total extended filament length and the settling characteristics of activated sludge to operating prototype treatment units was determined. The hypothesi that floc sizes in laboratory activated sludge units are smaller than in prototype units was also examined. Activated sludges from twelve California sewage treatment plants were used in the experiments. Results showed that settling properties of the activated sludge of full-scale plants after evaluation of reflocculation time, zone settling velocity, height of the 60-minute compact volume and sludge volume index were related to the total length of filamentous microorganisms using previous relationships developed for laboratory activated sludge units. In full-scale plant studies, the amount of filaments extending from the flocs had the greatest influence on settling properties of the activated sludge in both purely domestic and partially industrial sewage. No difference was observed in the mean maximum floc dimension between full-scale and laboratory-scale activated sludge treatment systems. (Geiger-FRC)
W81-00875

WASTE WATER FROM A CHEMICAL-PHARMACEUTICAL WORKS,
Boehringer, Mannheim (Germany, F.R.).
N. Reus, and H. Rueffer.
Progress in Water Technology, Vol 12, No 3, p 153-169, 1980. 11 Tab, 8 Ref.

Descriptors: *Biological treatment, *Industrial wastes, *Toxins, *Activated sludge, *Sewage bacteria, Waste water treatment, Water pollution, Sewage treatment, Chloroform, Solvents, Pilot plants, Organic compounds, Carbon tetrachloride, Nitrate.

The Boehringer Mannheim pharmaceutical company, which had formerly discharged about 40% of its wastewater into the Rhine River, was required in 1973 to discharge its wastes into a newly constructed municipal sewer. To reduce the load of oxidizable and noxious substances before discharge, several experiments were performed by the company to ascertain that effluents would not harm bacterial populations or sewer components. An adapted activated sludge was employed which was found to yield good biodegradability when mixed with sewage. The adapted sludge also functioned well in the presence of high levels of chloroform. All chlorinated hydrocarbons and solvents were decomposed by treatment processes in pilot plant tests. Step-by-step discharge of wastes was begun into the sewer in 1978 with no breakdown having occurred in the system up to the present time. The adapted sludge tolerated chloroform contents greatly in excess of acceptable toxicity levels. Controlled natural selection of sludge bacteria was also geared to handle carbon tetrachloride, methanol, nitrate and other toxic solvents. (Geiger-FRC)
W81-00876

COMPARISON OF COSTS OF FOUR MODIFICATIONS OF THE ACTIVATED SLUDGE PROCESS: AN EXAMPLE CASE,
Technische Hochschule, Vienna (Austria). Inst. fuer Wasserversorgung Abwasserreiningung und Gewasserschuts.
W. Floegl.
Progress in Water Technology, Vol 12, No 3, p 139-151, 1980. 8 Fig, 5 Tab, 5 Ref.

Descriptors: *Biological treatment, *Activated sludge, *Comparative costs, *Operating costs, Waste water treatment, Sludge digestion, Biochemical oxygen demand, Density, Human populations, Sewage treatment, Model studies, Theoretical analysis, Systems analysis, Annual equivalent costs.

Difficulties often arise in comparing costs of existing waste water treatment plants because of such external factors as location, overall economic situation of construction, plant equipment, safety features, and means of financing. To obtain a more objective comparison, four modifications of the activated sludge process with BOD5 effluents of less than or equal to 20 milligrams/liter were examined. The plant sizes covered population equivalents ranging from 50,000 to 500,000. The four modifications were: a one-stage activated sludge plant (a.s.p.) with primary treatment and sludge digestion; a one-stage a.s.p. without primary treatment, with sludge digestion; a one-stage a.s.p. without primary treatment, with simultaneous aerobic sludge stabilization; and a two-stage a.s.p. without primary treatment, with sludge digestion. Estimates were based on single cost positions to exclude external factors. Least expensive total annual costs were found with the one-stage type operation without primary treatment. Using a primary treatment alternative caused slight cost increases. Higher costs also occurred with an alternative with simultaneous aerobic stabilization and a two-stage alternative. (Geiger-FRC)
W81-00877

PRELIMINARY STUDIES ON COMBINED OR SEPARATE TREATMENT (AS EXPERIENCED WITH EFFLUENTS FROM INDUSTRIES PROCESSING WOOD),
Technische Hochschule, Vienna (Austria). Inst. fuer Wasserversorgung Abwasserreiningung und Gewasserschuts.
H. Fleckseder.
Progress in Water Technology, Vol 12, No 3, p 129-138, 1980. 13 Ref.

Descriptors: *Waste water treatment, *Sewage treatment, *Pulp and paper industry, *Cost analysis, *Theoretical analysis, Industrial wastes, Mathematical studies, Pulp wastes, Cost comparisons, Economics, Systems analysis, Model studies, Design, Wood wastes.

Qualitative and quantitative comparisons were made of five Austrian effluent treatment plants to evaluate the cost effectiveness and efficiency of the separate or combined approach to treatment of sewage and industrial effluents. One of the plants treated a fiberboard mill effluent, while the other four handled pulp mill effluents. The expected loads to each plant were assessed, and preliminary designs on connecting sewers were drawn up. Cost estimates were calculated, taking into account such variables as future plant expansions, urban development, and possible alternate discharge locations. It was recognized from these five cases that the appropriateness of combined or separate treatment of industrial wastes cannot be generalized and must take into account such individual factors as plant designs, management structures, topography, discharge schedules and regionalization. Although all five study sites favored combined treatment, it was suggested that cost evaluations be made for each individual plant under consideration. (Geiger-FRC).
W81-00878

INFLUENCE OF PHASE SEPARATION ON THE ANAEROBIC DIGESTION OF GLUCOSE-I. MAXIMUM COD-TURNOVER RATE DURING CONTINUOUS OPERATION,
Amsterdam Univ. (Netherlands).
A. Cohen, A. M. Breure, J. G. Van Andel, and A. Van Deursen.
Water Research, Vol 14, No 10, p 1439-1448, October, 1980. 7 Fig, 5 Tab, 41 Ref.

Descriptors: *Anaerobic digestion, *Chemical oxygen demand, *Fermentation, *Anaerobic bacteria, Sludge, Lipids, Separation techniques, Waste water treatment, Organic compounds, Acids, Sewage bacteria, Carbohydrates, Glucose.

An anaerobic digestion of a mineral medium containing 1% glucose was carried out in either one or two phases under similar conditions. The one-phase digestion system was comprised of an anaerobic up-flow with acidogenic and methanogenic populations to effect complete conversion of the carbon source into gaseous end products and biomass. The two-phase digestion system was composed of both an acid and a methane reactor in a series to permit sequential glucose acidogenesis and methanogenesis. Carbon mass balance was used to evaluate performance of the one-and-two-phase systems. Maximum turnover of COD was calculated by gradually increasing the feed supply of both systems. In the two-phase digestion process, maximum specific sludge loadings of the methanogenic phase were over 3 times greater than in the one-phase digestion system. In other experiments overloading was simulated with accumulation of volatile fatty acids. Propionate and acetate were formed in large quantities in the one-phase system, while accumulation of several fatty acids occurred in the two-phase system. After cessation of feed supply, only propionate remained in the one-phase system after one week and all fatty acids in the two-phase system were rapidly converted. The ecological and physiological importance of phase separation is also considered. (Geiger-FRC)
W81-00879

CONSTRUCTION ASPECTS OF OUTFALL DESIGN FOR GREATER ATHENS,
Hawksley (Watson), High Wycombe (England).
For primary bibliographic entry see Field 5E.
W81-00885

SEWAGE TREATMENT AND EFFLUENT DISPOSAL OPTIONS APPROPRIATE TO MEDITERRANEAN COASTAL DEVELOPMENTS AS STUDIED FOR GREATER ATHENS,
Hawksley (Watson), High Wycombe (England).
For primary bibliographic entry see Field 5E.
W81-00886

TRENDS IN COASTAL WASTE TREATMENT,
WAPORA, Inc., Chevy Chase, MD.
L. W. Olinger, and J. I. Bregman.
Progress in Water Technology, Vol 12, No 1, p 211-223, 1980. 4 Fig, 7 Ref.

Descriptors: *Monitoring, *Water pollution sources, *Waste water treatment, *Estuarine environment, *Sea water, Coasts, Costs, Regulation, Sewage effluents, Water quality, Sewage treatment.

American experiences in coastal water treatment are discussed, and their applicability to problems in the Mediterranean are briefly considered. The characteristics of estuarine and near-shore waters are presented including: tides, salinity, density, stratification, winds, bathymetry, and ecology. US laws and regulations which apply to waste water treatment facilities discharging into coastal areas are summarized. Advanced facilities of this type are described including water quality problems, annual or projected improvements in water quality, cost of the facility, and the economic impact of the facility on its users . The use of ocean outfalls for effluent disposal is examined including system design and effectiveness. Detailed water quality and biological studies of the receiving waters are recommended before construction of a costly advanced waste water treatment plant. A secondary treatment plant could be constructed on the site and monitored to see if this level of treatment is sufficient. Environmental monitoring programs should be used throughout the planning and treatment stages. (Small-FRC)
W81-00891

CONTROLLING ORGANIC COMPOUNDS IN WATER - BY TREATMENT,
T. Burke.
Water, No 34, p 17-19, September, 1980. 3 Fig, 3 Tab.

Descriptors: *Organic compounds, *Activated carbon, *Tertiary treatment, *Drinking water, *Adsorption, *Waste water treatment, Disinfection, Chlorination, Chlorinated hydrocarbon pesticides, Sewage treatment, Ozone, Public health, Costs, Water pollution treatment.

Possible health effects of synthetic organic compounds (SOC) in drinking water have necessitated changes in water treatment policies. The US EPA has passed laws limiting the level of trihalomethanes (THM) in drinking water to 0.10 milligrams/liter, and has required vulnerable utilities to install granular activated carbon (GAC) treatment processes. A variety of guidelines for safe levels of THMs in drinking water have been set by other nations. Control measures for limiting the level of SOCs and THMs in drinking water are reviewed. Studies in the United Kingdom were conducted to determine at which step of the treatment process efforts to limit THM formation should be concentrated. Alternatives to chlorine disinfection include ozonation and the use of chlorine dioxide. Flow diagrams are presented for typical GAC systems in a slow sand filtration plant and a chemical coagulation plant. The importance of selecting the correct carbon in treating different waters, and the costs of GAC absorption operations are considered. Research on SOC removal at the Water Research Center of the United Kingdom consists of desk, laboratory, and field studies. There remains no low cost solution to the removal of organic micropollutants in drinking water. Studies are also being conducted to ascertain the effects of low levels of organics in a variety of toxicity tests and epidemiological studies. (Geiger-FRC)
W81-00908

THE SECOND STAGE TREATMENT OF BIOLOGICALLY TREATED COAL CARBONIZING WASTES IN ADMIXTURE WITH SEWAGE,
Yorkshire Water Authority, Sheffields (England). Southern Div.
H. B. Tench.
Progress in Water Technology, Vol 12, No 3, p 221-230, 1980. 6 Tab, 2 Ref.

Descriptors: *Color, *Industrial wastes, *Sewage treatment, *Biological treatment, Waste water treatment, Rivers, Water pollution, Activated sludge, Mathematical studies, Model studies, Nitrification, Aeration, Adsorption, Water quality, Phenols, Iron compounds.

The further treatment of biologically treated coal carbonizing wastes by discharge to sewers was investigated in laboratory and full-scale tests. Carbonizing wastes were handled in admixture with sewage at levels of up to 20% in one aeration unit. Satisfactory performance was achieved if a sodium hydrogen carbonate buffer was added to increase the level of nitrification. Complex phenols produced a color in the carbonizing wastes which was not removed at the 20% additions. Ferric chloride treatment significantly removed the color in the effluent while serving as a sludge conditioner. When flocs occurred in the presence of the iron compound, most of the color was taken out by adsorption onto floc surfaces. Consent conditions for the discharge of the treated effluent by admixture with sewage established by the South Yorkshire Water Authority were aimed at permitting the survival of coarse fish. A simple mathematical model was proposed to calculate standards for discharge to a river or sewer. (Geiger-FRC)
W81-00911

ACTIVATED SLUDGE CONTROL IN THE SECONDARY SETTLING BASIN USING THE SLUDGE SETTLING ANALYZER,
Kanazawa Univ. (Japan). Dept. of Construction and Environmental Engineering.
S. Matsui, and N. Furuya.
Progress in Water Technology, Vol 12, No 3, p 213-220, 1980. 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Activated sludge, *Instrumentation, *Mathematical models, *Settling basins, *Equations, Analytical techniques, Municipal wastes, Model studies, Waste water treatment, Monitoring, Overflow, Suspended solids, Automation.

A new instrument, the settling sludge analyzer, which was developed to monitor the settling interface of sludge and analyze sludge settling curves is described. The instrument was used to compute sludge volumes in the secondary settling basin according to a new mathematical model based on two previous theories. The sludge settling analyzer was applied to small and large size municipal waste water treatment facilities. Calculations produced by the new instrument gave good agreement with actual sludge volumes in the secondary settling basins. The sludge settling analyzer also computed relations among concentration of return sludge, MLSS, SVI, and overflow rate of the secondary basin based on the new formula and measurements of the sludge settling interface. The relations were found to be useful in predicting operating criteria for overflow rate, design, return sludge ratio, the level of MLSS in the activated sludge system and excess sludge withdrawal. (Geiger-FRC)
W81-00912

INVESTIGATIONS ON THE PERFORMANCE OF UPFLOW FINAL SETTLING TANKS IN ACTIVATED SLUDGE PLANTS,
Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wasserguetewirtschaft und Gesundheitsingenieurwesen.
H. Resch.
Progress in Water Technology, Vol 12, No 3, p 201-211, 1980. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Activated sludge, *Settling basins, *Settling velocity, *Biological treatment, *Separation techniques, Sludge treatment, Pilot plants, Waste water treatment, Flocculation, Sewage treatment, Suspended solids, Effluents, Sedimentation, Structural shapes, Design, Germany.

In Germany, wastewater treatment processes characteristic of sludge blanket clarifiers are not considered, due to a preference for funnel-shaped final settling tanks with vertical upflow and 30% higher surface loadings. Activated sludge plants in Bavaria and Berlin which use Dortmund tanks for final settling were studied for surface loading, sludge return rate and levels of activated sludge. These 3 parameters were varied to examine their effect on effluent quality and distribution of suspended solids in the tanks. Additional studies were conducted in tube-shaped pilot settling tanks of the Ismaning plant to determine the influence of wastewater temperature, inlet depth, maximum loadings and

maximum sludge return rates on settling tank efficiency. The high load capacity of the Dortmund tanks was clearly demonstrated, while the effluent quality of the funnel shaped tanks with sludge blankets occurred with increased sludge volume loading. Effluent quality in the Dortmund tanks remained good provided sludge levels did not reach the water surface. (Geiger-FRC)
W81-00913

TREATMENT OF A FILAMENTOUS INDUSTRIAL WASTE IN A MUNICIPAL STEP AERATION PLANT,
Greeley and Hansen, Chicago, IL.
T. E. Wilson, G. Lukasik, and D. Ogle.
Progress in Water Technology, Vol 12, No 3, p 189-199, 1980. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Activated sludge, *Aeration, *Industrial wastes, *Biological treatment, *Microorganisms, *Suspended solids, *Water pollution sources, Waste water treatment, Municipal wastes, Settling velocity, Domestic wastes, Nitrification, Flocculation, Regulated flow.

A 12 mgd wastewater treatment plant employing a two-step, air activated sludge, nitrification process experienced serious problems when the aeration tank hydraulic and clarifier loading rates were increased sharply over the course of a start-up. Reduced treatment capacity occurred due to an increased number of filamentous organisms contributed by the effluent of an industrial wastewater treatment plant. Over a five day period during the course of the upset, this industry produced over 75% of the total influent suspended solids; it normally accounted for about 45% of the influent suspended solids. Plant process stability was regained and maintained by alterations in the first carbonaceous step and the aeration tank flow. Plug flow with no reaeration was replaced by a pattern in which 3 or 4 of the aeration passes were used for return sludge reaeration. Plant observations and test results of initial settling velocity showed that the treatment capacity of the municipal plant was related to the solids loading of the industrial wastewaters. (Geiger-FRC)
W81-00914

IMPLEMENTING PRETREATMENT REQUIREMENTS IN THE UNITED STATES: A STUDY OF FOUR PUBLIC AGENCIES TREATING DOMESTIC AND INDUSTRIAL WASTEWATER,
Lynam (Bart T.) and Associates, Chicago, IL.
For primary bibliographic entry see Field 6E.
W81-00916

THE EFFECT OF INTERNAL MASS TRANSFER RESISTANCES ON THE INTERPRETATION OF SUBSTRATE REMOVAL DATA IN THE SUSPENDED GROWTH SYSTEM,
Dorr-Oliver Inc., Stamford, CT.
W. K. Shieh.
Water Research, Vol 14, No 6, p 695-699, June, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Activated sludge, *Continuity equation, *Mass transfer, Theoretical analysis, Model studies, Kinetics, Flocculation, Mathematical studies, Separation techniques.

Suspended growth systems such as the activated sludge process are usually heterogeneous and autocatalytic, producing their own enzymes. A technical note is presented to theoretically demonstrate the significance of internal mass transfer resistances on the interpretation of the kinetic data of such systems. To examine these effects by the concept of an effectiveness factor, steady state conditions, simple soluble substrate, spherical microbial flocs with uniform size and composition, insignificant external mass transfer resistances and Monod kinetics were assumed. Three linearized plots used to evaluate kinetic constants were examined under cases of low and high ambient substrate concentrations. Large microbial floc conditions and low ambient substrate levels had a significant effect on the observed rate of the activated sludge process. The saturation utilization rate (k) in the Monod equation was not affected by internal mass transfer limitations when the Eadie-Hofstee and Lineweaver-Burk plots were used to determine kinetic parameters. Under the activated sludge suspended growth system, the three plots examined were not very sensitive to the effects of internal mass transfer resistances. (Geiger-FRC)
W81-00918

FIELD INFILTRATION AS A METHOD FOR THE DISPOSAL OF OIL-IN-WATER EMULSIONS FROM THE RESTORATION OF OIL-POLLUTED AQUIFERS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
H-O. Schiegg.
Water Research, Vol 14, No 8, p 1011-1016, August, 1980. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Potable water, *Aquifers, *Infiltration, *Oil spills, Water pollution, Retention, Model studies, Groundwater, Microbial degradation, Pumping, Path of pollutants, Emulsions, Jamin effect.

When oil accidents occur it becomes important to prevent permeation of the oil into aquifers that are used as potable water supplies. The use of water pumping to prevent the propagation of oil during a spill may result in oil-water emulsions with low oil content. Field infiltration of oil-water emulsions is often performed, with retention of oil by soil or its degradation by soil microbes. Field infiltrations use smaller amounts of fresh water than those required during pumping. It is also a simplistic and inexpensive technique. The major drawbacks of field infiltration are the uncertainty surrounding retention and the degree of microbial degradation of oil. The maximum retention capacity of oil due to the Jamin effect was investigated experimentally. Some hydromechanical principles of field infiltration by oil-water emulsions were also examined. The retention capacity for oil during infiltration of an oil-in-water emulsion at gravity flow rates was calculated to be definitely greater than the pendular saturation. The drop in the relative permeability of the wetting fluid was estimated to be even steeper after the retention of the non-wetting fluid by the Jamin effect than it was after a displacement. (Geiger-FRC)
W81-00920

LABORATORY STUDIES ON THE ADSORPTION OF ACRYLAMIDE MONOMER BY SLUDGE, SEDIMENTS, CLAYS, PEAT AND SYNTHETIC RESINS,
Plymouth Polytechnic (England). John Graymore Chemical Labs.
For primary bibliographic entry see Field 5B.
W81-00924

DISSOLVED AIR FLOTATION IN HOT WATER,
Department of Scientific and Industrial Research, Petone (New Zealand). Industrial Processing Div.
W. T. Shannon, and D. H. Buisson.
Water Research, Vol 14, No 7, p 759-765, July, 1980. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Flotation, *Thermal water, *Waste water treatment, Bubbling, Geothermal studies, Water pollution, Flocculation, Temperature, Iron, Dissolved oxygen, Industrial wastes, New Zealand.

The use of dissolved air flotation (DAF) in the treatment of hot geothermal wastewater and other hot industrial effluents was evaluated in an experimental rig at 50-90 degrees. The efficiency of air dissolution (by spraying water over proprietary packing), bubble size distributions, and the air-solids ratios necessary for iron floc flotation were similar at 80 degrees to values observed at ambient temperatures. Costs for the DAF saturation process were estimated to be comparable to those for ambient temperature systems due to reduced viscosity and density of the water at higher temperatures and increased water vapor pressures above 65 degrees. Tests on iron flocs yielded an 80% removal efficiency, which would be satisfactory in geothermal work at Wairakei, New Zealand. Bubble rise rates at 80 degrees were found to be three times faster than at 20 degrees. The onset of severe bubble coalescence at 80 degrees took place at air dissolution pressures above 350 kPa. (Geiger-FRC)
W81-00926

APPLICATION OF WATER EXTRACT OF BROWN COAL FLY ASH TO PHOSPHATE PRECIPITATION FROM POLLUTED WATERS,
Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.
I. Kuziemska.
Water Research, Vol 14, No 9, p 1289-1293, September, 1980. 7 Fig, 4 Tab, 8 Ref.

Descriptors: *Chemical precipitation, *Phosphates, *Fly ash, *Coagulation, Alkalinity, Hardness, Suspended solids, Mathematical studies, Model studies, Municipal wastes, Waste water treatment, Eutrophication, Powerplants.

Brown coal fly ash taken from the Konin power plant was tested as a coagulant in a technique to precipitate phosphate from municipal wastes and strongly polluted water. Suspended solids were sedimented easily and improvements in BOD and COD were observed. A substantial amount of phosphate ion was precipitated immediately after the coagulant was introduced and after intensive mixing of the solution. Mathematical multiple regression models and experimental data have confirmed that the alkalinity and volume ratio of reacting waters and the total alkalinity of the tested water have the most significant influence on the degree of phosphate precipitation achieved. No effect on the process was found when reactant alkalinities in the range of 40 milliequivalent to 53 milliequivalent per liter were used. These two parameters enable 75% reliability in the prediction of phosphate ion precipitation from waters of known total hardness and alkalinity. (Geiger-FRC)
W81-00928

ON THE MECHANISM OF DEWATERING COLLOIDAL AQUEOUS SOLUTIONS BY FREEZE-THAW PROCESSES,
Columbia Univ., New York. Dept. of Chemical Engineering and Applied Chemistry.
G. Ezekwo, H-M. Tong, and C. C. Gryte.
Water Research, Vol 14, No 8, p 1079-1088, August, 1980. 7 Fig, 1 Tab, 40 Ref.

Descriptors: *Dewatering, *Sludge treatment, Freezing, Sewage sludge, Waste water treatment, Domestic wastes, Separation techniques, Crystallization, Analytical techniques, Solidification.

Freezing has been considered as an alternative to sludge dewatering and the conditions and extent to which the aqueous component in sludge can be solidified to ice were investigated. A partially digested sludge taken from the Coney Island Sewage Treatment Plant was subjected to a temperature gradient to -30 degrees. Crystal morphologies of freeze-dried samples were examined, thermal analyses were carried out, and water contents of drained gels were determined. Thermal analysis showed that about 50% water remained in the segregated solute matrix after freezing. Freezing of sludge resulted in the segregation of the solute, both dissolved and suspended, in a zone between the ice crystal domains. Dewatering was strongly dependent on retention of the form of the solute matrix during the melting process. To minimize the freezing time in potential freeze flocculation processes, the use of small particles was recommended. (Geiger-FRC)
W81-00931

NITROGEN TRANSFORMATIONS IN A SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEM,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. L. Chen, and W. H. Patrick, Jr.
Water Research, Vol 14, No 8, p 1041-1046, August, 1980. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Denitrification, *Nitrogen, *Model studies, *Overland flow, *Water purification, Nitrification, Municipal wastes, Industrial wastes, Waste water treatment, Adsorption, Nitrates, Nutrients, Water pollution.

Removal of pollutants by overland flow treatment has been suggested as an effective and economical technique for the purification of municipal and industrial waste water. It was proposed that a significant quantity of nitrogen could be removed by a properly planned nitrification-denitrification overland flow system. An overland flow test model was constructed to evaluate the efficiency of ammoniacal-nitrogen removal from waste water. Results showed removal of ammoniacal nitrogen, with the subsequent formation of nitrate. Radioactively-labeled nitrogen was used to examine nitrogen balance in the simulated overland flow system. Model studies revealed that the quantity of nitrogen removed depended upon denitrification rates. Nitrogen was absorbed by the soil, while applied ammoniacal nitrogen was assimilated by the vegetation. Ammoniacal nitrogen absorbed into the aerated soil surface mass underwent nitrification and was converted to oxidized forms of nitrogen. During subsequent wastewater applications, the nitrate diffused downward to the reduced zone, where some of it was denitrified to gaseous forms of nitrogen or was reduced to organic nitrogen by assimilation. The net loss of nitrogen which was observed in the overland flow system proved less than that predicted from non-labeled nitrogen mass balance estimations. (Geiger-FRC)
W81-00934

NITRIFICATION KINETICS IN ACTIVATED SLUDGE AT VARIOUS TEMPERATURES AND DISSOLVED OXYGEN CONCENTRATIONS,
Imperial Chemical Industries Ltd., Billingham (England). Dept. of Research and Development.
R. C. Charley, D. G. Hooper, and A. G. McLee.
Water Research, Vol 14, No 10, p 1387-1396, October, 1980. 8 Fig, 6 Tab.

Descriptors: *Nitrification, *Kinetics, *Activated sludge, *Dissolved oxygen, Model studies, Temperature, Domestic wastes, Sewage bacteria, Ammonia, Biochemical oxygen demand, Chemical reactions, Waste water treatment, Biological treatment.

Due to the growing concern over oxygen depletion by ammonia compounds in waste water, a study was undertaken to investigate the kinetics of nitrification under various temperatures and different levels of dissolved oxygen in activated sludge from a domestic sewage works. The effects of high concentrations of dissolved oxygen upon nitrifying bacteria were also studied in a 'Deep Shaft' effluent treatment process. The sludge was enriched with nitrifying bacteria by running a laboratory fermenter on ammonia supplemented sewage. Microbial nitrification kinetics were evaluated in respirometric studies. The reaction was found to be in agreement with the Michaelis - Menton model in the temperature range of 10-35 degrees. After acclimatization, high amounts of dissolved oxygen (38 milligrams/liter 02 at 30 degrees) had little effect on nitrification. However, the reaction was inhibited by nitrite levels in excess of 20 milligrams/liter. (Geiger-FRC)
W81-00937

MECHANISM AND KINETICS OF CYANIDE OZONATION IN WATER,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
J. A. Zeevalkink, D. C. Visser, P. Arnoldy, and C. Boelhouwer.
Water Research, Vol 14, No 10, p 1375-1385, October, 1980. 11 Fig, 4 Tab, 37 Ref.

Descriptors: *Ozone, *Mathematical studies, *Cyanide, *Oxidation, *Chemical reactions, Kinetics, Industrial wastes, Waste water treatment, Theoretical analysis, Laboratory tests.

The ozonation of potassium cyanide is of interest for its potential application in the treatment of cyanide bearing waste waters from industrial sources. The reaction has been studied in alkaline solutions buffered at a pH of 11.8 and a temperature of 20 degrees in a stirred tank reactor. The mass transfer parameters of the reactor have been determined by measuring the gas-liquid interfacial area and the physical mass transfer coefficient for different reaction condtions. Initial cyanide levels were about 100 grams/cubic meter. The reaction rate under these conditions may be described by an equation which is of first order with respect to ozone and independent of the levels of cyanide. Results of mass transfer studies showed that one mole of ozone oxidized one mole of cyanide; however, the reaction rate was so great that the conversion was limited by mass transfer. A reaction rate equation was predicted by the mechanism proposed for cyanide oxidation, and was supported by experimental data. The mechanisms proposed for the decomposition of ozone and the oxidation of cyanide were found to be similar. The kinetics proposed for the decay of ozone are in agreement with experimental data from the literature. (Geiger-FRC)
W81-00938

TYPE AND STRAIN DEPENDENCE OF ENTEROVIRUS ADSORPTION TO ACTIVATED SLUDGE, SOILS AND ESTUARINE SEDIMENTS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
C. P. Gerba, S. M. Goyal, C. J. Hurst, and R. L. LaBelle.
Water Research, Vol 14, No 9, p 1197-1198, September, 1980. 1 Tab, 10 Ref.

Descriptors: *Viruses, *Adsorption, *Sediments, *Activated sludge, *Separation techniques, Soils, Suspended solids, Sewage effluents, Sea water, Waste water treatment, Laboratory test, Water purification, Sewage sludge, Loam, Sewage treatment.

The adsorption of enteric viruses to solids is believed to play an important part in their removal during sewage treatment processes. A study was conducted to determine if quantitative differences existed in the adsorptive behavior of different types and strains of enteroviruses toward surfaces known to influence their distribution in nature. Viral suspensions containing 1 to 10 million plaque-forming units were added to 1 to 10 grams of solids (soil, activated sludge or sediments) in either distilled water, sewage effluent or sea water. Solid:liquid ratios were 1:1, 1:140, and 1:7 for soil, activated sludge and sediment, respectively. Suspensions were mixed and then centrifuged, and the supernatants were assayed for viral content and compared with solid-free control preparations. Adsorption to solids was found to be dependent on virus type as well as strain. Great variability was seen in viral adsorption to soil, while little variation was noted in viral adsorptive behavior on estuarine sediments. Viral adsorption to solids is known to depend upon isoelectric point of the virus, which varies in different viral types and strains. Isotherm data for soil and sediments has also revealed different viral adsorptive capacities in these materials. These findings suggest that the type of solids present during sewage treatment may greatly influence the viral removal capacity of the process. (Geiger-FRC)
W81-00939

BIOLOGICAL TREATMENT OF A COAL GASIFICATION PROCESS WASTEWATER,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. G. Luthy, and J. T. Tallon.
Water Research, Vol 14, No 9, p 1269-1282, September, 1980. 11 Fig, 5 Tab, 25 Ref.

Descriptors: *Industrial wastes, *Biological treatment, *Oxidation, *Organic compounds, *Waste treatment, Alkalinity, Waste water treatment, Chemical oxygen demand, Ammonia, Kinetics, Pilot plants, Sewage bacteria, Coal gasification waste water.

The efficiency of biological treatment on Hygas coal gasification process plant waste water was evaluated over an 8 month period. The waste water was composed of cyclone and quench condensates. The treatability of ammonia stripped and unstripped waste water at full strength and at 1:1 dilution was studied. The minimum pre-treatment needed for biological oxidation was calculated to consist of reducing the alkalinity and decreasing the raw ammonia level by dilution or stripping. Kinetic studies indicated that the waste water could be processed at mean cell residence times ranging from 10 to 40 days with 2 to 3 day hydraulic residence periods. The decay coefficient of Hygas wastes was 0.01/day, while the bacteriological yield coefficient was 0.10 on a chemical oxygen demand basis. Bacterial growth inhibition by Hygas waste water was attributed to short cell residence times. Although higher yield coefficients were achieved with diluted waste water, no problems with organic waste removal efficiencies were predicted under recommended processing parameters. (Geiger-FRC)
W81-00944

RESPONSE OF DISSOLVED OXYGEN TO CHANGES IN INFLUENT ORGANIC LOADING TO ACTIVATED SLUDGE SYSTEMS,
Vanderbilt Univ., Nashville, TN.
C. Y. Chen, J. A. Roth, and W. W. Eckenfelder, Jr.
Water Research, Vol 14, No 10, p 1449-1457, October, 1980. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Activated sludge, *Dissolved oxygen, *Organic compounds, *Biochemical oxygen demand, *Chemical oxygen demand, Monitoring, Respiration, Laboratory tests, Mathematical studies, Equations, Aeration, Model studies, Waste water treatment.

Responses of activated sludge to transient organic loadings and the effects of dissolved oxygen (DO) levels and oxygen uptake rates as control variables of the process were examined in a modified laboratory-scale activated sludge unit. The concentration of ambient dissolved oxygen was continuously monitored for changes due to the influent composition of the wastewater. While the system was kept in a steady state, system variables were measured for MLVSS (mixed liquor volatile suspended solids), soluble TOC (total organic carbon) and rate of oxygen uptake. By increasing or decreasing the baseline feeding of TOC level, organic shock loading was induced. When a transient loading took place, DO monitoring was accomplished with a DO analyzer. A material balance equation for DO in the system was formulated, and the dynamics of the oxygen uptake rate were investigated. Under transient conditions, the fluctuations in DO levels reflected changes in the exogenous respiration rate of the biomass in the system due to variations in the influent waste. Due to the rapid response to shock loading and the correlation between DO changes and the magnitude of shock loading, it was suggested that DO and oxygen uptake rate could be used as control variables for the activated sludge process. (Geiger-FRC)
W81-00946

TECHNICAL, ECONOMIC AND ENVIRONMENTAL ASPECTS OF WET AND DRY DEBARKING.
Water and Pollution Control, Vol 118, No 9, p 34, 36, September, 1980. 1 Ref.

Descriptors: *Wood wastes, *Waste water treatment, *Bark, Pulp wastes, Saw mills, Water pollution control, Industrial wastes, Costs, Suspended solids.

A summary of a report on waste water technology, including debarking processes, is presented. Wet and dry debarking operations are compared in terms of energy requirements, economics, product quality, and effect on manufacturing processes. A review is also presented of waste-water treatment alternatives representing technically feasible and economically viable systems which would permit the discharge or recycling of debarker waste water of acceptable quality. Systems using hydraulic jets, mechanical rings, wet drums, and dry drums in debarking arrangements were investigated. Varia-

bles that influence the efficiency of wet and dry debarking include the wood species, harvesting and debarking seasons, log quality, and storage methods. The projected cost of effluent control has been the major reason for both saw mills and pulp mills shifting from wet to dry debarking techniques. Savings roughly balance the additional costs. Current effluent treatment for wet debarkers is focused upon suspended solids removed. Improved techniques will be necessary for many wet debarkers to conform to present and projected future effluent regulations. (Baker-FRC)
W81-00954

EFFLUENT QUALITY VARIATION FROM MULTICOMPONENT SUBSTRATES IN THE ACTIVATED SLUDGE PROCESS,
Middle East Technical Univ., Ankara (Turkey). Dept. of Environmental Engineering.
S. Siber, and W. W. Eckenfelder.
Water Research, Vol 14, No 5, p 471-476, May, 1980. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Waste water treatment, *Activated sludge, *Mathematical models, *Total organic carbon, *Kinetics, Statistics, Suspended solids, Water quality, Analytical techniques, Biological degradation.

The authors tested the validity of mathematical models using three substrates (glucose, phenol, and sulfanilic acid) of widely differing removal rates in the activated sludge process. Sludge from a municipal sewage treatment plant was acclimated as a seed in a continuous flow, completely mixed laboratory reactor. A mixture of the three substrates in varying combinations was fed at different food/microorganism (F/M) ratios. Total organic carbon (TOC) was the parameter chosen to measure overall removal rates. Specific analytical measurements for each substrate in the influent and effluent samples were also made. Models relating the effluent quality in terms of soluble TOC to F/M or to sludge age were presented. The authors concluded from their studies that the overall substrate removal rate in terms of TOC was the sum of the individual substrate removal rates. The substrate removal rates were shown to decrease with increasing sludge age and decreasing F/M. The calculated and experimentally determined biodegradable fraction of the mixed liquor volatile suspended solids was shown to increase with increasing organic loading. (McKenon-FRC)
W81-00962

CONTAMINATION OF GROUND WATER SUPPLIES BY TRICHLOROETHYLENE--THREE CASE HISTORIES,
Weston (Roy F.), Inc., West Chester, PA.
W. J. Duffy, R. Moose, and S. J. Tomalavage.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 187-200. 3 Fig, 2 Tab. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Water pollution control, *Organic compounds, *Groundwater resources, *Chlorides, Pennsylvania, Water pollution, Adsorption, Solvents, Industrial wastes, Trichloroethylene.

Clean groundwater is a resource that is rapidly becoming depleted in suburbanized areas throughout the United States, in part because of extensive contamination by organic solvents such as trichloroethylene (TCE) and methyl chloride (MC). Two important properties relating to groundwater contamination are specific gravity and solubility. Both TCE and MC are heavier than water and only slightly soluble; therfore, when spilled neither degrades but begins moving downward within the aquifer. Chlorinated hydrocarbons will remain stable in a subsurface environment essentially forever. Three programs in Pennsylvania to renovate groundwater resources show that while air-stripping is often a viable procedure, it cannot be used in all situations. Numerous other techniques to remove volatile hydrocarbons are available, such as adsorption of organic compounds by synthetic resins or activated carbon. However, maintenance costs and costs of disposal of used materials are problems associated with these technologies. Studies of these aquifers should be considered so that if subsequent contamination occurs, baseline data will be available to define and determine the contaminants. Monitored use of solvents within the industry, as well as increased public awareness of the problems created by use of these compounds, may prevent continued degradation of groundwater resources. (Garrison-Omniplan)
W81-00964

TREATMENT OF MILILANI STP EFFLUENT FOR DRIP IRRIGATION OF SUGARCANE,
Hawaii Univ., Honolulu.
E. K. F. Liu, and R. H. F. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144651, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Hawaii, Honolulu, Technical Report No 128, July, 1979. 32 p, 13 Fig, 9 Tab, 19 Ref. 14-34-0001-9013.

Descriptors: *Waste treatment, *Water reuse, *Drip irrigation, *Sewage effluents, Return flow, Physicochemical properties, Sugarcane, Ditches, Irrigation systems.

The secondary effluent of the Mililani STP is intended for use in the drip irrigation of sugarcane. The relative success of this waste water reuse application is affected by the concentration of suspended solids in the sewage effluent. Chemical coagulation, dissolved air flotation, and granular media filtration were studied in the laboratory to determine the most cost-effective means of obtaining a sewage effluent with a suspended solids content similar to that of the water from Waiahole Ditch presently used in drip irrigation. Of the three methods tested, granular media filtration with anthracite coal-silica sand media at a flow rate of .001 7 cu m/s/sq m (2.5 gpm/sq ft) was a cost-effective method of producing a sewage effluent with suspended solids concentration in the range of that found in Waiahole Ditch water during dry weather. Model laboratory testing shows that application of this sewage effluent will not adversely affect the type of filter media used in drip irrigation. Preliminary analysis of the residual solids distribution found in the sewage effluent after this posttreatment shows that failure of the drip irrigation system due to excessive plugging should not be a problem. The estimated annual cost of this treatment system is $147,000 based on a 0.16 cu m/s (3.6-mgd) flow, or $40,830/mgd. (Author's abstract)
W81-00984

IRON REMOVAL BY ROTATING CONTACT REACTOR,
Missouri Univ.-Columbia. Dept. of Sanitary Engineering.
L. W. Tharpe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144644, Price codes: A03 in paper copy, A01 in microfiche. Master of Science Thesis, May, 1979. 31 p, 8 Fig, 2 Tab, 16 Ref. OWRT-B-124-MO (3).

Descriptors: *Iron, *Water purification, *Water treatment, Equipment, Instrumentation, *Waste water treatment, Research and development, Ferrobacillus, Iron bacteria, Microorganisms, Water quality, Treatment, Quality control, Separation techniques, Impaired water quality, Waste water(Pollution), Evaluation, Testing, Rotors, Research equipment, Flow rates, Flow, Oxidation.

Feasibility assessment was made of using a rotating contact reactor to remove iron (Fe(II)) from water. Total soluble iron was determined using the Hach-Ferrozine method. The study was conducted in two phases: (1) determination of Fe(II) removal kinetics for the reactor at various flow rates, and (2) evaluation of the effect of disc surface area on overall Fe(II) removal. Hydraulic detention times less than fifty minutes reduced the percent removal of Fe(II) (from about 99%), according to a first-order (linear) relationship between Fe(II) removal and contactor stage detention time (slope: 2.13/minute). The rotating contactor could achieve 96-99% removal of total iron from a ferrous iron feed stream having a concentration up to 28 milligrams per liter. With eleven or six rotating discs, 99% Fe(II) removal was obtained; but this declined to 81% with all discs removed. Since stabilization of the rotating contactor after changing the flow rate was achieved in such short times (one day or less) relative to times required for biological systems (5-6 days), the oxidation and removal of Fe(II) was probably due to physiochemical activity. Rotation of the discs promotes aeration and mixing, and increases the efficiency of Fe(II) removal. (Zielinski-IPA)
W81-00985

5E. Ultimate Disposal Of Wastes

TRANSPORT OF POTENTIAL POLLUTANTS IN RUNOFF WATER FROM LAND AREAS RECEIVING ANIMAL WASTES: A REVIEW,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W81-00775

PROCESSES CONTROLLING VIRUS INACTIVATION IN COASTAL WATERS,
Harvard Univ., Cambridge, MA. Lab. of Microbial Ecology.
R. B. Kapuscinski, and R. Mitchell.
Water Research, Vol 14, No 4, p 363-371, April, 1980. 2 Tab, 133 Ref.

Descriptors: *Water quality, *Viruses, *Marine bacteria, *Coasts, *Sewage effluents, Bacteriophage, Heavy metals, Suspended solids, Sludge disposal, Ultimate disposal, Coagulation, Solid wastes.

The biological, chemical, and physical processes that control virus inactivation in coastal waters are reviewed. An understanding of these processes is necessary for effective control of contamination in coastal waters used for human waste disposal. Evidence for a biological mechanism of dieoff comes from the isolation and identification of specific marine bacteria capable of inactivating viruses. However, their activity in the field is unknown. Heavy metals have been implicated as being possibly virucidal in seawater, but the concentrations and complexes are not known. A thermal mechanism does not appear to be of primary significance, although temperature-correlated, seasonal variations in die-off rates have been reported. Laboratory experiments on virus adsorption predict that as much as 99% of the viruses present in coastal marine waters are adsorbed to naturally occurring colloidal and particulate matter. Other evidence indicates that viruses apparently survive longer in seawater in the adsorbed state. Laboratory studies of viral inactivation rates range from 1 to 43 days when expressed as the time required for 90% dieoff. These slow dieoff rates emphasize the need for more effective virus removal form sludge effluent. Increased control and efficiency of coagulation and sedimentation units for particulate and gross solids removal would appear to be one important step in controlling viral contamination of coastal waters. (McKeon-FRC)
W81-00788

CONSTRUCTION ASPECTS OF OUTFALL DESIGN FOR GREATER ATHENS,
Hawksley (Watson), High Wycombe (England).
K. D. Staples, and J. J. Guilfoyle.
Progress in Water Technology, Vol 12, No 1, p 245-261, 1980. 5 Fig, 5 Ref.

Descriptors: *Outfall sewers, *Project planning, *Feasibility studies, *Waste water disposal, Europe, Coasts, Construction, Construction costs, Engineers estimates, Municipal wastes, Sewerage, Athens, Mediterranean Sea.

The feasibility and cost of construction of marine outfalls for the disposal of liquid wastes from Athens were determined. A comprehensive data base is considered necessary and should include information about marine conditions, geological

and geotechnical conditions, local contracting capabilities, and engineering ability to assess all of the available data. Because of the low velocity of currents in the Mediterranean, a high degree of treatment is necessary before discharge. The hydraulic characteristics of the outfall and the diffuser design are presented. Possible outfall routes are proposed, and specific construction methods are discussed. Estimated costs are included for various proposals. (Small-FRC)
W81-00885

SEWAGE TREATMENT AND EFFLUENT DISPOSAL OPTIONS APPROPRIATE TO MEDITERRANEAN COASTAL DEVELOPMENTS AS STUDIED FOR GREATER ATHENS,
Hawksley (Watson), High Wycombe (England).
S. D. Myers, and C. M. Ainger.
Progress in Water Technology, Vol 12, No 1, p 225-244, 1980. 4 Fig, 6 Tab.

Descriptors: *Waste water disposal, *Project planning, *Outfall sewers, Coasts, Contract administration, Bids, Waste water treatment, Europe, Sewage disposal, Liquid wastes, Municipal wastes, Athens, Mediterranean Sea.

The characteristics and requirements of liquid waste disposal for the Athens area were determined. The most suitable and most economic method was that of a settled effluent discharged through along outfall. Other situations along the Mediterranean call for different solutions. Small developments far from the coast require high quality effluents for discharge on to land or to torrents. Developments which need additional facilities to meet the demands of tourists can adapt land-based treatment for these seasonal loads rather than invest in a long outfall system. Alternative treatment and disposal options should be considered carefully. If sedimentation/long outfall or chemically assisted sedimentation/short outfall systems are to be installed, they must be specified in the tender documents calling for turnkey bids. (Small-FRC)
W81-00886

LEACHATE COLLECTION USING THE GROUND-WATER FLOW SYSTEM: A LANDFILL CASE HISTORY IN CENTRAL PENNSYLVANIA,
Meiser & Earl/Hydrologists, State College, Pennsylvania.
E. W. Meiser, Jr., T. A. Earl, and R. M. Bodner.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 214-227. 7 Fig. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Landfills, *Leachate, *Linings, *Waste storage, *Waste disposal, Pennsylvania, Waste treatment, Waste dumps, Clays, Lagoons, Disposal, Groundwater resources, Construction costs.

Waste disposal sites which rely on natural renovation of leachate in thick, suitably textured soils are becoming rare as regulations describing site requirements become more stringent. Fulkroad's Landfill in Pennsylvania is an example of a natural renovation landfill that meets Pennsylvania leachate treatment requirements. It is located on dissected rolling upland approximately 600 feet above sea level. The fundamental concept underlying the design is that groundwater flow in a shallow groundwater setting is upwards, converging on a definable discharge zone where leachate can be intercepted. The landfill area is restricted to a single groundwater basin. All the base flow is then collected into a groundwater interceptor drain system, and the cost of a liner is eliminated. The leachate treatment utilizes an aerated lagoon, a settling lagoon, a stream discharge in wet weather and spray irrigation discharge during dry months, with provisions for a future lime-addition system. Given the tight hydrogeologic setting, the authors conclude that this technique can perform reliably and safely. It is hoped that EPA's Resource Conservation and Recovery Act guidelines will be revised to permit a reevaluation of acceptable liners beyond the current requirement of several feet of low permeability clay---often a prohibitively expensive installation. (Garrison-Omniplan)
W81-00965

DISPOSAL OF LAKE SEDIMENTS CONTAINING ARSENIC,
Strand Associates, Inc., Madison, WI.
M. D. Doran, and M. A. Anderson.
In: Third Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 10-12, 1980, p 429-440. 5 Fig, 2 Tab. University of Wisconsin-Extension, Department of Engineering & Applied Sciences, 432 N. Lake Street, Madison, WI 53706.

Descriptors: *Lake sediments, *Sedimentation, *Dredging, *Water pollution, *Arsenic compounds, Wisconsin, Groundwater resources, Disposal, Waste disposal, Wells, Potable water, Clays, Waste storage.

During the 1950's and 1960's, a total of 27,000 pounds of arsenic as sodium arsenite was applied to Little Muskego Lake in Wisconsin to control aquatic macrophytes that interfered with recreational usage. The proposed project would remove about 2.25 million cubic yards of sediment---7,000 pounds of the applied arsenic---by hydraulic dredging, and deposit it in a disposal site near a large number of private water supply wells. The study suggests that arsenic contamination of groundwater is unlikely and even under worst case anaerobic conditions, soluble arsenic concentrations would still be expected to meet drinking water standards. Sediment arsenic is strongly adsorbed by sediment solids and by native soils from the disposal sites. The dissolved arsenic concentrations would not exceed 50 micrograms/L within the sites, and would decrease in concentration to 5 micrograms/L after passing through only a few centimeters of native soil. To provide an additional safety factor, a minimum of eighteen inches of clayey bottom soil, along with groundwater quality monitoring, is proposed at the disposal sites. (Garrison-Omniplan)
W81-00966

5F. Water Treatment and Quality Alteration

EVALUATION OF PROCEDURES FOR RECOVERY OF VIRUSES FROM WATER. I. CONCENTRATION SYSTEMS,
Severn Trent Water Authority, Coventry (England). Regional Lab.
R. Morris, and W. M. Waite.
Water Research, Vol 14, No 7, p 791-793, July, 1980. 3 Tab, 11 Ref.

Descriptors: *Viruses, *Filters, *Adsorption, Potable water, Rivers, Biological membranes, Separation techniques, Water purification, Analytical techniques, Aluminum, Cation adsorption, Cations, Monitoring, Aquatic ecosystems.

Two fiberglass filters and one cellulosic filter were evaluated for the recovery of poliovirus type 2 seeded into tap and river waters. The organic flocculation technique was used as a standard secondary concentration procedure with the aim of establishing a reliable method for the routine virological monitoring of aquatic ecosystems. The role of aluminum cations in viral recovery was also investigated. The best recoveries were obtained with fiberglass filters used in conjunction with 0.005 M AlCl3 x 6H20. A four-fold greater efficiency was achieved in fiberglass filters with added aluminum cations than without the aluminum cations. No such effect from the addition of aluminum cations was observed in the viral recovery efficiency of the cellulose nitrate membrane filters. The efficiency of organic flocculation as a secondary concentration step varied with viral serotypes used. The methods investigated were considered suitable for recovery of enteroviruses from tap and river water. (See also W81-00767) (Geiger-FRC)
W81-00766

MODE OF BACTERIAL INACTIVATION BY CHLORINE DIOXIDE,
John Hopkins Univ., Baltimore, MD. Div. of Environmental Health Engineering.
S. D. Roller, V. P. Olivieri, and K. Kawata.
Water Research, Vol 14, No 6, p 635-641, June, 1980. 6 Fig, 17 Ref.

Descriptors: *Bacteria, *Disinfection, *Chlorine dioxide, *Mode of action, E. coli, Chlorination, Viability, Proteins, Pollutants, Water treatment, Potable water, Chlorine, Enzymes.

The effects of chlorine dioxide, an alternative for chlorine as a water disinfectant, on the dehydrogenase enzymes, protein synthesis, and deoxyribonucleic acid (DNA) of bacteria were examined. Tests were conducted in a unit which allowed sampling for bacterial survivals from 5 to 1800 seconds after chlorine dioxide addition. The pour plate method was used to assess bacterial numbers, and total dehydrogenase activity of E. coli was measured colorimetrically. Cell extracts were evaluated for their ability to incorporate radioactive phenylalanine into protein, and DNA from Haemophilus influenzae treated with chlorine dioxide was tested for its ability to transform competent cells. The transformability of partially purified DNA exposed to chlorine dioxide was also determined. Results showed a complete inhibition of total dehydrogenase activity within the first 5 seconds of exposure. Protein synthesis was inhibited by chlorine dioxide in a dose-dependent manner. Treatment with glutathione did not reverse the effects of the disinfectant on total dehydrogenase activity, protein synthesis, or bacterial viability. Chlorine dioxide had no observable effect on the DNA transforming ability of whole cells or partially purified DNA extracts of H. influenzae. It was concluded that neither dehydrogenases, DNA, nor proteins are the major site of action of chlorine dioxide on bacterial cells, although inhibition of protein synthesis may play a part in cell mortality. (Geiger-FRC)
W81-00864

KINETICS OF SORPTION AND DESORPTION OF HCL AND LOW MOLECULAR WEIGHT ORGANIC ACIDS BY STYRENE AND ACRYLIC WEAK BASE RESINS,
Chemical Technology Inst., Prague Czechoslovakia). Dept. of Power Engineering.
Z. Matejka, and J. Eliasek.
Water Research, Vol 14, No 5, p 467-470, May, 1980. 4 Tab, 5 Ref.

Descriptors: *Acids, *Sorption, *Ion exchange, Resins, Plastics, Kinetics, Inorganic acids, Organic acids, Separation techniques, Gels, Diffusion.

The diffusion rates of HCl and low-molecular weight organic acids such as caproic acid and sulfosalicyclic acid were compared on polystyrene and acrylic weak base resins for sorption and desorption. The kinetics for comparison of the individual resins were calculated on the basis of a reaction half-time. The effects of macroporous or gelular matrix on the kinetic properties for styrene and acrylic resins were determined and compared. Acrylic resins were preferable for sorption and desorption of HCl at low concentrations. The macroporous-styrene resins were better at higher concentrations. At all concentrations the sorption of low-molecular organic acids was primarily controlled by selectivity and proceeded faster on acrylic resins. The concentration of the elution solution governed desorption. Desorption occurred faster on macroporous styrene resins. The macroporous matrix in general had a substantially smaller kinetic advantage for acrylic than for styrene weak base resins. (Baker-FRC)
W81-00867

THE PRODUCTION OF BROMOPHENOLS RESULTING FROM THE CHLORINATION OF WATERS CONTAINING BROMIDE ION AND PHENOL,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
J. A. Sweetman, and M. S. Simmons.
Water Research, Vol 14, No 3, p 287-290, March,

1980. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Chlorination, *Phenols, *Water treatment, *Bromide, Water pollution sources, Chemistry, Halogens, Aromatic compounds, Ammonia, Laboratory tests.

Chlorine-induced bromination using phenol as a model compound was investigated as part of a study of possible formation of brominated phenols during the chlorination of natural waters. The water sample to be chlorinated contained both phenol and bromide ion at a pH of 7.4. Direct bromination with H0Br was tested at four ratios of H0Br:phenol. In all cases the main product was 2,6,6-tribromophenol. Chlorine-induced bromination with equimolar amounts of hypochlorous acid and KBr added produced 2,4,6-tribromophenol. The findings suggest that chlorination, bromination and mixed halogenation products should be expected when water that contains bromide ion undergoes chlorination. The presence of ammonia in the water can affect the outcome. (Baker-FRC)
W81-00871

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETIC PARTICLES-I. USE OF MAGNETIC CATION EXCHANGE RESINS TO INTRODUCE ALUMINIUM IONS,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Engineering.
N. J. Anderson, R. J. Eldridge, L. O. Kolarik, E. A. Swinton, and D. E. Weiss.
Water Research, Vol 14, No 8, p 959-966, August, 1980. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Flocculation, *Turbidity, *Surface waters, *Aluminum, *Cation exchange, Suspended solids, Separation techniques, Sludge, Hardness, Color, Iron oxides, Water purification, Water treatment, Adsorption, Magnetism.

The recovery of suspended solids from surface waters by magnetic action exchange resins was studied in laboratory test. An amberlite CG50 resin and a magnetic PVA acrylic acid graft resin were examined for Al and Fe cation adsorption. Results showed that 70-80% loadings of Al and 15-30% loadings of Fe could be achieved under the range of pH values tested. Other experiments using resins of various particle sizes were conducted, with and without the incorporation of magnetic iron oxide into the resins. When the resin beads were small they acted as nuclei for floc settling, and flocculation was accelerated. When magnetic iron oxide was incorporated into the resin beads, they were easily separable from the clarified water. Partial reloading of the resin with Al cations was carried out by acidification of the resin-containing sludge. Hydrolysis of Al ions within the resin made the regenerated sludge ineffective as a coagulant. (Geiger-FRC)
W81-00882

AN EPIDEMIOLOGIC STUDY OF THE RELATIONSHIP BETWEEN HEPATITIS A AND WATER SUPPLY CHARACTERISTICS AND TREATMENT,
Health Research Lab., Cincinnati, OH.
O. Batik, G. F. Craun, R. W. Tuthill, and D. F. Kraemer.
American Journal of Public Health, Vol 70, No 2, p 167-168, February, 1980. 9 Ref.

Descriptors: *Viruses, *Disinfection, *Human diseases, *Epidemiology, *Potable water, Chlorination, Water treatment, Public health, Water pollution, Morbidity, Water pollution sources, Water supply, Statistics.

Outbreaks of hepatitis A (HA) have been associated with drinking water contamination. An ecological cross-sectional study was conducted to determine whether water source or water treatment processes impact upon endemic rates of HA. Only counties of the state studied which had distinct water treatment and distribution systems were included in the investigation. State Health Department records of HA morbidity data from 1965 to 1977 were utilized, and demographic variables were examined to control for factors which might influence HA morbidity rates. Results showed that none of the water supply source or treatment variables was significantly correlated with HA age-adjusted morbidity ratios. A statistically significant relationship was noted between mean annual HA rates and the median age of the county population. It was suggested that the hypothesized relationship between water treatment processes and HA might not have been detectable on the county data level and therefore, weak relationships between the two on an individual basis should not be ruled out. (Geiger-FRC)
W81-00897

PRECHLORINATION TREATMENT OF WATER TO REDUCE CHLOROFORM LEVELS,
Kansas Univ., Lawrence. Dept. of Chemistry.
K. Voss, T. Votapka, and C. Bricker.
Water Research, Vol 14, No 7, p 921-926, July, 1980. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Water treatment, *Trihalomethanes, *Chloroform, *Water quality, *Humic acids, Public health, Potable water, Decomposing organic matter, Chlorination, Gas chromatography.

In an effort to remove the precursors of trihalomethanes (THM), solutions of humic acid as well as Kansas River water were treated with potassium permanganate (KMnO4), potassium ferrate (K2FeO4) or hydrogen peroxide (H2O2) prior to chlorination. Ferrate pretreatment had no effect in reducing the amount of chloroform produced when water containing humic acid was chlorinated. Pretreatment of humic acid solutions with KMnO4 at an initial pH of 10.3 prior to chlorination significantly reduced the formation of chloroform. A 5 ppm solution of humic acid treated with H2O2 at a pH of 10.3 for 68 hr and then with hypochlorite for 16 hr had no detectable chloroform present. Kansas River water treated with H2O2 and hypochlorite also had chloroform levels below detectable limits. All solution preparation and analytical conditions and methodologies are described in detail. (McKeon-FRC)
W81-00921

CALCIUM CARBONATE HEXAHYDRATE: ITS PROPERTIES AND FORMATION IN LIME-SODA SOFTENING,
Essex Water Co., Maldon (England).
J. G. Slack.
Water Research, Vol 14, No 7, p 799-804, July, 1980. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Water softening, *Lime, *Calcium carbonate, *Hydrates, Hardness, Water treatment, Precipitation, Calcium compounds, Chemical properties, Separation techniques, Rivers, Crystallization, Hydration, Calcite, Sodium compounds.

The occurrence of supersaturation during lime/soda water softening is usually associated with the formation of a metastable hexahydrate of calcium carbonate that crystallizes when conditions are unfavorable for production of the usual calcite product. This hexahydrate has been reported to occur at several water treatment works for Essex River waters. Formation of the hydrated salt was favored by high orthophosphate levels and low water temperatures. The pure well-defined crystals formed by calcium carbonate hexahydrate were much more soluble in water than calcite crystals. When the hydrated product crystallized, the efficiency of the lime/soda water softening process was considerably reduced, requiring increased chemicals for softening and subsequent stabilization of softened water. Hexahydrate formation has been considerably reduced by phosphate precipitation by ferric salts before softening and by seeding with pre-fabricated calcite nuclei to induce calcite crystal formation. (Geiger-FRC)
W81-00923

APPLICATION OF WATER EXTRACT OF BROWN COAL FLY ASH TO PHOSPHATE PRECIPITATION FROM POLLUTED WATERS,
Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 5D.
W81-00928

LAKE RESTORATION BY DILUTION: MOSES LAKE, WASHINGTON,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, and C. R. Patmont.
Water Research, Vol 14, No 9, p 1317-1325, September, 1980. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Lakes, *Algae, *Eutrophication, Cyanophyta, Nuisance algae, *Water quality control, Nutrients, Nutrient removal, Water quality, Chlorophyll, Phosphorus, Reclamation, Water pollution control, Washington.

Low nutrient water from the Columbia River was added to Moses Lake at Parker Horn on three occasions in 1977 and once in 1978, during the spring-summer period. Chlorophyll a decreased to a May-September mean of about 15 microg/liter in 1978, which was a reduction of almost 80% in Parker Horn compared with 1969-70 values, and over 60% elsewhere in the lake. Total phosphorus (P) declined as much as 50-60% below the 1969-1970 values, but still remained rather high (70-90 microg/liter). Following dilution, blue-green algae comprised much less of the plankton crop (96% in 1970 compared with 68% in 1977-78). On an annual basis the dilution water did not show such a marked impact on P inflow concentration, reducing it from about 130-140 microg/liter to 100 microg/liter. Thus, the striking improvement in blue-green algal levels was apparently caused by factors other than a limitation on the pool of total P, and may be related to dilution of blue-green excretory products. A dilution water input of about 6 cu m/s continuously during April-September should provide adequate control of eutrophication in at least 30% of the lake volume proximal to the input and Parker Horn. That would provide an exchange rate of 5%/day for Parker Horn and should achieve lake water residuals of $<$ or $=$ 50% by midsummer. Two additional inputs to the lake are proposed for Phases II and III of the restoration project. (McKeon-FRC)
W81-00955

THE EFFECTIVENESS OF CHLORINE RESIDUALS IN INACTIVATION OF BACTERIA AND VIRUSES INTRODUCED BY POST-TREATMENT CONTAMINATION,
Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
M. C. Snead, V. P. Olivieri, K. Kawata, and C. W. Kruse.
Water Research, Vol 14, No 5, p 403-408, May, 1980. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Chlorination, *Viruses, *Bacteria, *Distribution systems, *Water pollution, Disinfection, Shigella, Salmonella, Coliforms, Hydrogen ion concentration, Temperature, Potable water, Sewage, Sewage treatment, Laboratory tests, Simulation analysis, Resistance, Public health, Water quality, Water pollution sources.

The effectiveness of a chlorine residual in water distribution systems in protecting against bacterial and viral contamination was investigated in a simulated situation of cross connection contamination by autoclaved raw sewage spiked with 2 viruses and 3 bacteria. Tap water was adjusted to the proper pH, temperature and residual chlorine level, then challenged with varying levels of the autoclaved sewage seeded with Salmonella typhimurium, Shigella sonnei, a coliform (IMVIC $++--$), poliovirus 1 and bacterial virus f2. Survival of the sewage contaminants was determined over a 2 hour period. Microbial inactivation increased with decreasing pH and sewage levels and increasing temperatures and chlorine levels. A greater inactivation of microbes occurred with an initial free chlorine residual than was found with an equivalent initial combined chlorine residual. The most resistant species was bacterial virus f2, followed by poliovirus 1 and the three bacterial organisms. A bacterial inactivation of 3 logs or greater and a

viral inactivation of less than 2 logs was achieved after 1 hour with addded sewage levels up to 1% by volume at pH 8 and an initial free chlorine residual of 0.7 mg/liter. (Geiger-FRC)
W81-00960

5G. Water Quality Control

INTERACTION OF BACTERIOPHAGE R17 AND REOVIRUS TYPE III WITH THE CLAY MINERAL ALLOPHANE,
Waikato Univ., Hamilton (New Zealand). Dept. of Chemistry.
D. H. Taylor, A. R. Bellamy, and A. T. Wilson.
Water Research, Vol 14, No 4, p 339-346, April, 1980. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *Adsorption, *Clay minerals, *Viruses, *Water purification, Montmorillonite, Infection, Hydrogen ion concentration, Kinetics, Bacteriophage, Suspended solids, Kaolinite, Illite, Suspensions, Natural streams, Phosphates, Sodium chloride, Salts, Freshwater, Radioactivity, Physical properties.

Clay minerals have been shown to be effective adsorbents of viruses due to the high surface area provided by their fine particle size. The use of clay minerals as a means of reducing virus particles in water purification seems attractive due to the readily available supply of these substances at low costs. The effectiveness of the amorphous aluminosilicate clay mineral allophane as an adsorbent for R17 bacteriophage and reovirus type III was examined. The principal factors affecting adsorption were found to be mixing time, pH, and the concentrations and isoelectric points of both the allophane and the viruses. Allophane exhibited good adsorption of both reovirus type III and the R17 bacteriophage in the pH range of 5 to 7, corresponding to the pH range of many natural freshwater systems. Experiments using highly purified radioactively labeled reovirus were conducted to investigate the kinetics of virus adsorption to allophane. Virus desorption was studied in solutions of sodium chloride, sodium phosphate, and sodium hexametaphosphate. These studies made it possible to follow the distribution of the virus in a clay suspension and observe its specific infectivity. When adsorbed virus was eluted by neutral phosphate solutions it retained its physical integrity but had a lower specific infectivity. (Geiger-FRC)
W81-00781

CATCHMENT QUALITY CONTROL,
Thames Water Authority, London (England). Directorate of Scientific Services.
L. B. Wood, and M. L. Richardson.
Progress in Water Technology, Vol 12, No 3, p 1-12, 1980. 2 Fig, 10 Tab, 9 Ref.

Descriptors: *Quality control, *Potable water, *Methodology, *Chemicals, *Rivers, Water quality, Reclaimed water, Industrial wastes, Surfactants, Runoff, Water pollution sources, Detergents, Europe, Thames River, Lee River, London, United Kingdom.

A procedure was established for assessing the nature and concentrations of micropollutants from all sources in river water used for potable supply. This report deals with micropollutants from the following sources; industrial discharges, agricultural and highway run-off, and domestic wastes. Domestic wastes include pharmaceutical products, detergents, cosmetics, toiletries, and disinfectants. Studies were made of the quality of the water in the Lee River and Thames River near London. Results are given for: micropollutants in the Lee River derived from industrial sources, micropollutants in the non-tidal Thames and Lee Rivers, and concentration of non-ionic surfactants in the Thames and Lee Rivers. Despite the wide range of sources of chemicals that could enter the water cycle, no particular hazard was found. (Small-FRC)
W81-00854

BLUE-GREEN ALGAE IN LAKE MJOSA AND OTHER NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W81-00859

THE CASE OF LAKE MJOSA,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W81-00860

APPLICATION OF US OECD EUTROPHICATION STUDY RESULTS TO DEEP LAKES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W81-00862

WELL WATER QUALITY ON MOEN ISLAND, TRUK,
Guam Univ., Agana. Water Resources Research Center.
R. N. Clayshulte, and W. J. Zolan.
Technical Report No 13, September, 1980. 36 p, 12 Fig, 11 Tab, 12 Ref, 1 Append.

Descriptors: *Guam, *Wells, *Groundwater, *Water pollution sources, Chemical analysis, *Water quality, Chlorination, Anaerobic bacteria, Nitrogen compounds, Disinfection, Potable water, Water temperature, Subsurface investigations, Physical properties.

A study was begun in May 1979 to determine the water quality of production wells connected to the distribution system of Moen Island. Six wells were monitored on a monthly basis for one year. Basic physical, chemical and bacteriological parameters were measured from water samples collected at each well head after a minimum one minute flushing period. Average well water pH ranged from 6.21 to 6.54. Levels of free carbon dioxide were generally high; however, dissolved nitrogen and phosphorus concentrations were low. Dissolved nutrients do not effect the structural components of the wells. Mean temperatures were consistent between the wells and were not considered abnormally high. Alakalinity values were always in the form of bicarbonate alkalinity, and showed decreases from January to May 1980. Chlorine levels were low except for one well. The mean turbidity levels of 4 wells were in violation of the territorial safe drinking water standard. Sulfate and reactive silicate concentrations were low in all of the well waters. Contamination is the major problem associated with production wells, including frequent total coliform bacteria and high turbidity levels. These imply groundwater contamination. Recommendations to improve well water quality include: disinfection procedures, monitoring programs, and methods to determine sources of contamination. (Vernale-Omniplan)
W81-00866

EVALUATING THE TOXICITY OF EFFLUENTS,
Los Angeles Bureau of Sanitation, CA.
For primary bibliographic entry see Field 6E.
W81-00915

WHOLE LAKE RESPONSES TO LOW LEVEL COPPER SULFATE TREATMENT,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. W. Effler, S. Litten, S. D. Field, T. Tong-Ngork, and F. Hale.
Water Research, Vol 14, No 10, p 1489-1499, October, 1980. 12 Fig, 2 Tab, 49 Ref.

Descriptors: *Copper sulfate, *Aquatic life, *Monitoring, *Environmental effects, *Algicides, *Sampling, Aquatic bacteria, Nutrients, Phosphorus, Aquatic algae, Lakes, Pesticides, Zooplankton, Aquatic populations, Cazenovia Lake(NY).

A time intensive monitoring program was used to evaluate the toxicity of three low level copper sulfate applications (455 kg CuSO4x5H2O in a 10% solution) to Cazenovia Lake, New York. Filtered and total copper, type and number of phytoplankton, in situ assimilation of radioactively labeled carbon, bacterial numbers, enumeration and identification of zooplankton, the status of macrophyte nutrients, and filtered and reactive total phosphorus were assessed. Copper sulfate treatment caused only a slight increase in filtered copper levels, with maxima of 5 micrograms/liter over a 2-5 day period. No algicidal action resulted from the low level applications; however, short term stress and changes in the natural seasonal succession within these populations were observed. No significant effects upon the zooplankton, submerged macrophytes, or amounts of phosphorus in the water column were found due to the low level treatments. After each copper sulfate application, sharp decreases were noted in the water column bacteria, showing the direct negative impact of the treatment. After several days, recoveries in bacterial populations were observed. Phytoplankton populations reached normal levels within 1 week after copper sulfate treatment. (Geiger-FRC)
W81-00947

AERATION AS A TOOL TO IMPROVE WATER QUALITY AND REDUCE THE GROWTH OF HYDRILLA,
University of South Florida, Tampa.
For primary bibliographic entry see Field 4A.
W81-00961

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

A SYSTEMS APPROACH TO SOLVING RESOURCE ALLOCATION PROBLEMS WITH MULTIPLE OBJECTIVES,
California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 4A.
W81-00751

EXPANDED FLOOD PLAIN INFORMATION STUDY WILLOW, ALASKA.
Corps of Engineers, Anchorage, AK. Alaska District.
For primary bibliographic entry see Field 4A.
W81-00757

ESSENTIALS OF GROUND-WATER HYDROLOGY PERTINENT TO WATER-RESOURCES PLANNING,
Water Resources Council, Washington, D. C. Hydrology Committee.
For primary bibliographic entry see Field 2F.
W81-00759

GREEN RIVER BASIN OPTIMIZATION - SIMULATION MODEL,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
H. Yazicigil, G. H. Toebes, and M. H. Houck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143356, Price codes: A10 in paper copy, A01 in microfiche. Technical Report No 137, November, 1980. 190 p, 74 Fig, 32 Tab, 26 Ref, 2 Append. OWRT B-094-IND(5).

Descriptors: *Model studies, *Optimization, *Reservoir operations, *Flood control, *Recreation, *Low flow augmentation, River forecasting, Reservoir management, Reservoir releases, Reservoir storage, Synthetic hydrology, Flow augmentation, Reservoir yield, Kentucky, *Green River basin(KY).

The report presents an optimal operation of an existing multi-purpose multireservoir system using forecasts. An optimization - simulation model is constructed for a system of four flood control reservoirs in the Green River Basin, Kentucky, having recreation and low-flow augmentation as secondary objectives. The resulting model, called GRB0PM2, is designed for use in real-time as well as in long-run operation studies. The descriptive

components of the model consists of a segmented model comprising nine multi-input linear (MIL) models of the river system downstream of the four reservoirs; whereas the prescriptive component is largely in the form of an operating policy algorithm that involves repeated solution of a mathematical problem. The optimization technique employed to solve the mathematical program is Linear Programming. The use of the GRBOPM2 model in long-run reservoirs operations studies is demonstrated. The systems responses under various operating and hydrologic conditions have been obtained. In particular trade-off curves between various systems' objectives were generated both for winter and summer sessions by using historical hydrologic as well as synthetic model input data.
W81-00806

SCALING IMPACTS OF ALTERNATIVE PLANS,
Colorado Univ. at Boulder. Center for Research on Judgement and Policy.
For primary bibliographic entry see Field 6B.
W81-00838

PUMPED STORAGE SITE SELECTION PROCESS AS DEVELOPED BY THE SALT RIVER PROJECT, PHOENIX, ARIZONA,
Salt River Project, Phoenix, AZ.
G. D. Harris.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 190-206. 7 Fig, 68 Ref.

Descriptors: *Pumped storage, *Reservoir sites, *Hydroelectric plants, *Decision making, Reservoirs, Planning, Arizona, Evaluation, Cost analysis, Topography, *Phoenix(AZ).

Current projections of the demand for electrical power in Arizona indicate that the portion of the Phoenix Metropolitan area served by the Salt River Project will have sufficient generation capacity to provide for the base load for the foreseeable future, but that peak period demand will exceed the generation capacity in the early 1990s. A study was undertaken to select the best site in Arizona for a new hydroelectric pumped storage facility. A total of 138 sites were identified, based on topography. A series of three screening processes was applied to the sites. Screening was guided by two primary premises: all screens were to be positively pass or fail, and the screens were to be in a sequence that allowed dropping a number of sites based on existing information before screens requiring additonal research were applied. The screening procedure left a total of 16 sites. Further evaluation left six sites for which cost estimates were developed. One site, Alchesay Canyon, was selected for further study, with four backup sites. (Moore-SRC)
W81-00853

URBAN WATER SUPPLY PLANNING,
Southern Illinois Univ., Carbondale.
D. D. Baumann, and J. J. Boland.
Water Spectrum, Vol 12, No 4, p 33-41, Fall, 1980. 1 Fig, 1 Tab.

Descriptors: *Planning, *Water management, *Water resource development, *Water utilization, Urban hydrology, Efficiencies, Costs, Water resources, Water quality, Water supply, Water requirements.

Present urban water supply planning has become a challenging and complex task. Today's problems in planning reflect not only an inadequate supply, but a wide range of factors involving projection and management. Water conservation, i.e., a beneficial reduction in water use or water loss, is increasingly important. All water conservation practices are components of efficient management of water resources. The water resource planner must consider the efficient allocation of water resources at every stage of distribution and use. Many problems are associated with measuring the effectiveness of potential water conservation techniques. Urban water supply planning is influenced by environmental restrictions, laws and regulations, water quality criteria, increased energy costs, and water resource development expenses and water demands. Various approaches available to the water resource planner are discussed, and the effectiveness of each is evaluated. (Geiger-FRC)
W81-00910

COMMUNITY PLANNING FOR WATER RESOURCES MANAGEMENT, A GUIDEBOOK.
Skidmore, Owings, and Merrill, Boston, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144867, Price codes: A03 in paper copy, A01 in microfiche. Publication prepared for Office of Water Research and Technology, September, 1979. 24 p, 6 Fig. OWRT-C-80104-P(No 8402)(2).

Descriptors: *Water resources development, *Planning, *Community development, *Water utilization, *Water resources planning, Resources, City planning, Economics, Urbanization, Rural areas, Alternate planning, Evaluation, Cities, Legislation, Legal aspects, Institutions, Institutional constraints, Alternative water use, Comprehensive planning, Governments, Water resources, Administration, Management.

This guidebook provides a step-by-step method to help local officials and concerned citizens solve their water resources problems by developing a community water resources management plan. Five specific steps are outlined in the planning process (with participation in planning factored into each of these steps): (1) definition of problems and goals; (2) collection and study of available data; (3) generation of a set of alternatives; (4) evaluation of the possible effects of each alternative; and (5) selection of a course of action leading from point of decision to implementation. Selection of the official or agency for a given town or city that is best prepared or most appropriate to initiating action was recommended. Numerous examples are provided for the detailed five-step process. The procedures described are designed to assist individuals in the creation of a water resources management plan to suit their community. The steps may be modified or reiterated in order to effect optimum results. The guidebook is written in a personal guidance narrative form. (Zielinski-IPA)
W81-00970

EFFECTS OF ALTERED FRESHWATER INFLOW ON ESTUARINE SYSTEMS,
Texas Univ. at Austin. Environmental Health Engineering Lab.
For primary bibliographic entry see Field 2L.
W81-00992

6B. Evaluation Process

SCALING IMPACTS OF ALTERNATIVE PLANS,
Colorado Univ. at Boulder. Center for Research on Judgement and Policy.
C. A. Brown, R. J. Quinn, and K. R. Hammond.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-128886, Price codes: A06 in paper copy, A01 in microfiche. Water and Power Resources Service Report, June 1980. 109 p, 24 Fig, 6 Ref, 7 Append. 8-02407.

Descriptors: *Water resources development, *Alternative planning, Environmental effects, Social impact, Reliability, Measurement, Evaluation, Value, Planning, Validity.

The report describes procedures for improving measurement of the effects of alternative water development plans - particularly environmental and social impacts. Basic issues in measurement are related to the task of comparing alternative plans. Four types of measurement scales are evaluated in terms of their usefulness in the planning process. The concepts of reliability and validity are discussed in detail as is the concept of a measurement standard. Measurements required for water resources planning are divided into four types: Type I - Objective application of a measurement standard; Type II - Subjective application of a measurement standard; Type III - Subjective application of general scientific principles; Type IV - Subjective application of personal values. Procedures are presented for improving measurement types II, III, and IV, focusing on: (1) Disaggregating multidimensional factors (e.g., social well-being) (2) Defining factors and subfactors; (3) Specifying relations between factors and subfactors; (4) Integrating subfactor impacts; and (5) Defining higher order factors. (Author's abstract)
W81-00838

A STUDY OF THE IMPACT OF THE HUGO RESERVOIR ON CHOCTAW AND PUSHMATAHA COUNTIES: A VIEW FOUR YEARS AFTER COMPLETION.
Evans (R. E.) and Associates, Norman, OK.
Army Engineer Institute for Water Resources Research Report 80-R1, April 1980. 241 p, 13 Fig, 53 Tab, 38 Ref, 5 Append.

Descriptors: *Economic impact, *Reservoirs, *Social impact, *Post-impoundment, *Oklahoma, Economic prediction, Reservoir construction, Employment, Recreation, Agriculture, Human population, Construction, Powerplants, Land use, Forecasting, *Hugo Reservoir(OK).

In 1967 the Corps of Engineers commissioned a pro-forma study of the impact of the Hugo Reservoir on two Southeastern Oklahoma counties, Choctaw and Pushmataha. More than ten years have passed since the first study and the construction of the reservoir were begun and more than four years have elapsed since water impoundment in the reservoir began. The actual effects of the reservoir on the study area is compared with the effects forecast by the earlier study, and new forecasts are based on the effects already experienced. The impacts measured in this study were for the short-term period, 1967-1977, and the forecasts extend to 2050 in most cases. The population of the area increased by nearly 3,000 persons between 1967 and 1977. The labor force, per capita income, farm output, value added by manufacture and bank deposits have all increased during the same period. Total construction activity in the area by 1977 exceeded the level of 1967 by $11 million, and a rapid increase in construction is projected for the period between 1980 and 2000 due to the construction of a new coal fired generating plant. The creation of the Hugo reservoir resulted in the emergence of the recreation industry as a major econmic activity in the area. The use of land changed little between 1967 and 1978, although residential uses near the lake increased by 24 acres. (Moore-SRC)
W81-00881

RIVER RECREATION USE AND ANALYSIS OF CARRYING CAPACITY,
Vermont Univ., Burlington.
R. E. Manning.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-145088, Price codes: A05 in paper copy, A01 in microfiche. Vermont Water Resources Research Center, University of Vermont, Technical Completion Report, October, 1980. 83 p, 13 Fig, 23 Tab, 68 Ref, 4 Append, OWRT-A-034-VT(1), 14-34-0001-9048.

Descriptors: *Recreation demand, *Vermont, *Rivers, *Social aspects, Water types, Recreation, Fishing, Boating, Swimming, Evaluation, Synoptic analysis, Recreation facilities, Social carrying capacity, River types, River management, User satisfaction.

The major objectives of this study were to describe the nature and intensity of river recreation activity in Vermont and to develop methods for determining the social carrying capacity of rivers for recreation. The principal research method was a field survey of recreationists on four major Vermont rivers during the spring and summer of 1978. Substantial dissatisfaction was found among river users

with regard to selected river use problems and conflicts. Several systematic relationships were found between recreation activity patterns and river type as defined by physical/biological characteristics and cultural setting. Each of six river types examined demonstrated distinctive patterns of recreation behavior with regard to type and intensity of recreation activities, desired use densities, and problems and conflicts experienced by recreationists. These relationships provide an important initial base upon which to structure comprehensive river recreation planning and management. This study recommends special efforts to protect and preserve the recreation values of Vermont's rivers and streams.
W81-00972

OPTIMAL REGIONAL CONJUNCTIVE WATER MANAGEMENT,
Auslam and Associates, Sacramento, CA.
J. E. Noel, B. D. Gardner, and C. V. Moore.
American Journal of Agricultural Economics, Vol 62, No 3, p 489-498, August, 1980. 1 Fig, 7 Tab, 26 Ref. OWRT-B-187-CAL(6).

Descriptors: *Model studies, *Water allocation(Applied), *Cost analysis, *Water costs, *Water management(Applied), Pumping, Water utilization, Taxes, Management, Mathematics, Estimating, Analytical techniques, Simulation, Research and development, Testing, Water rates, Water sources, Water supply, Agriculture, Cities, Groundwater management, Groundwater, Surface waters, Economics.

An optimal control model was briefly described for determining the optimal spatial and temporal allocation of groundwater and surface water among agricultural and urban uses. The control model was then applied to a representative California region (Yolo County) under several sets of energy costs. Two policies (pro-rata allocation and taxation) were evaluated empirically as alternatives for accounting for externalities due to the common pool problem. The advantages of the control model over other dynamic models were enumerated. Optimal rates of groundwater pumpage over the planning horizon were highly sensitive to increasing energy costs. Groundwater basins are shown to react differently to alternative economic and hydrological parameters. In a dynamic setting, a policy of pump taxes was shown empirically to be superior to pro-rata quotas and uncontrolled pumpage. The two broad policy implications drawn from the results were that the areal size of a water resource-planning unit must be carefully chosen, and that certain economic impacts associate with policy alternatives for moving current groundwater allocations to a more socially preferred set. (Zielinski-IPA)
W81-00988

ESTIMATING ECONOMIC DEVELOPMENT IMPACTS; AN ALTERNATIVE APPROACH,
Washington Univ., St. Louis. Inst. for Urban and Regional Studies.
E. Greenberg, C. L. Leven, J. T. Little, and R. P. Parks.
Institute for Water Resources Contract Report 80-C3, August, 1980. 39 p, 1 Append.

Descriptors: *Economic impact, *Water resources development, *Mathematical models, Leontief models, Model studies, Economics, Investment, Project benefits, Regional economics, Employment.

Federally financed investments have a variety of impacts on the immediate region in which they are located. An alternate approach to estimating economic development benefits is outlined for water resources projects. A critique of the typical approach to estimating economic developmental impacts indicates that traditional Leontief-type calculations are valid under certain circumstances. A more general model of economic impact uses labor as one factor and land, waterways, or recreational sites as another. In the two-factor, two-good model, the two goods represent a range of goods in the real world, one good labor intensive and the other intensive in the use of the factor which the project affects. The effects of the project are changes in technology, factor prices, or factor endowments. The impact is measured as the percentage change in Gross Regional Product due to the changes in the infrastructure. The method outlined offers a good basis for an experimental effort at estimating economic impacts of a project in an alternate way that is both more defensible theoretically and calls for less data, though of a somewhat less conventional sort. (Moore-SRC)
W81-00989

THE EVALUATION OF WATER CONSERVATION FOR MUNICIPAL AND INDUSTRIAL WATER SUPPLY: PROCEDURES MANUAL,
Planning and Management Consultants Ltd., Carbondale, IL.
D. D. Baumann, J. J. Boland, and J. H. Sims.
Army Engineer Institute for Water Resources Contract Report 80-1, April, 1980. 73 p, 5 Fig, 1 Tab, 2 Append.

Descriptors: *Water conservation, *Evaluation, *Municipal water, *Industrial water, Cost-benefit analysis, Planning, Water supply, Social aspects, Alternative planning, Economics, Water demand.

Water conservation proposals serve to reduce the gap between future demand and future water supply. Specific water conservation measures may be classified as regulatory practices, management practices or education efforts. The evaluation procedure is used to determine whether water supply plans can be improved by inclusion of a water conservation element. Water supply plans are first formulated according to existing procedures, without consideration of additional water conservation measures. The potential water conservation measures are identified by the measure-specific analysis; these individual water conservation measures then are evaluated against the alternate water supply plans. Based on this evaluation, water conservation proposals are developed, which can be integrated into water supply plans, yielding alternative water supply/conservation plans. Determining the social acceptability of conservation measures requires the measurement of social ideologies. Interviews and surveys can be used to delineate social ideologies which affect the social acceptability of conservation measures. Two sample questionnaires are provided. (Moore-SRC)
W81-01000

6E. Water Law and Institutions

CLEAN WATER ACT'S PRECEPTS TO ENDURE,
Environmental Protection Agency, Springfield, IL.
M. Mauzy.
Water and Sewage Works, Vol 127, No 10, p 38-40, October, 1980.

Descriptors: *Clean water act, *Financing, *Management, *Administration, Economics, Legislation, Permits, Water quality standards, Regulation, Monitoring, Grants, Operation.

Changes are expected during the 1980s in regard to administrative decisions affecting water quality improvement legislation. However, the magnitude of these changes is expected to be somewhat less than has been experienced in the past decade. Desires will be balanced with realistic goals. Economics will become important in the making of decisions. Attention must be given to the management of the various programs. Decentralization of program administration is recommended. Simplications are needed in the various regulations, with incentives introduced and maintained in the management levels of regulatory programs. Changes will be made in the awarding of construction grants and in the ways in which wastewater facilities are to be operated. Concern will continue in the area of toxic pollutants in the environment, and increased testing will be performed on laboratory animals to determine possible toxic effects on humans. Programs will be developed for controlling nonpoint sources of pollutants. (Baker-FRC)
W81-00798

FLORIDA WATER LAW 1980,
Florida Water Resources Research Center, Gainesville.
F. E. Maloney, S. J. Plager, R. C. Ausness, and B. D. E. Canter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143430, Price codes: A99 in paper copy, A01 in microfiche. Publication No 50, 1980. 780 p, 6 Fig, 2,532 Ref. OWRT B-030-FLA(3), 14-34-0001-7113.

Descriptors: *Florida, *Water law, *Water resources development, Legislation, Judicial decisions, Planning, Legal aspects, Water pollution, Flood plain zoning, Riparian rights, Permits, Administration, Prior appropriation, Civil law, Regulation, Boundaries, Public rights, Navigation, Submerged lands.

This study is a comprehensive examination of the law respecting water use and management in the State of Florida. Common law water rights are analyzed in the first chapter, with particular attention given to the reasonable use rule. Chapter II describes the multitude of state and local agencies responsible for managing water resources in Florida. Chaper III surveys the various water allocation systems of the Eastern United States, emphasizing the Florida Water Resources Act of 1972. Common law and statutory restrictions on water pollution are analyzed in Chapter IV. The various legal doctrines governing the disposal of diffused surface waters are the subject of Chapter V. Finally, Chapter VI is concerned with submerged lands and water boundaries. The legal concept of navigability is explored and the significance of the ordinary high water mark and the mean high water line are examined.
W81-00802

INSTITUTIONAL CONSTRAINTS ON ALTERNATIVE WATER FOR ENERGY, A GUIDEBOOK FOR REGIONAL ASSESSMENTS.
Department of Energy Report DOE/EV/10180-01, November, 1980. 234 p, 15 Fig, 162 Ref.

Descriptors: *Groundwater, *Return flow, *Municipal wastes, *Saline water, *Water law, Constraints, *Impaired water use, *Powerplants, Groundwater mining, Irrigation systems, Sea water, Legal aspects, Political aspects, Social aspects, Sites, Thermal water, Prior appropriation, Water rights, Regulation, Regional analysis.

A guide is presented to the legal, political, and social constraints faced by energy developers in the acquistition of water from underground, irrigation return flow, municipal waste and saline sources. Water laws, environmental reporting, facility siting, and land use laws embody many of the institutional constraints relating to water acquisition. Whatever the stated rules with respect to water allocation, gaps sometimes exist between legal principles and practice. The principal legal systems for groundwater are absolute ownership, reasonable use, correlative rights and prior appropriation. In some states there are restrictions on groundwater mining, restrictions on off-site use, protection for holders of affected surface water rights and land owners, protection against unreasonable reductions in pressure or water table level, preferences for nonenergy uses, short time periods for putting water diligently to use, and uncertainties about the legal status of deep water, saline water, and geothermal water. The major constraint concerning the acquisition of municipal waste water for energy pertains to ownership. In many areas the return flow from irrigation is already covered by the water rights of downstream users. The acquisition of ocean water is not normally directly regulated; rather the intake structures, thermal discharges and siting are regulated. Social and political opposition to a project can transform what are otherwise procedural steps associated with water acquisition into major constraints and obstacles. (Moore-SRC)
W81-00892

THE MONOPOLIES GAME,
L. Freeman.
Water, No 34, p 22-23, September, 1980.

Descriptors: *Costs, *Efficiencies, *Water management, *Public rights, *Monopoly, Administrative agencies, Economic justification, Investigations, Legal aspects.

The United Kingdom's Monopolies and Mergers Commission has been investigating the efficiency of the Severn Trent Water Authority. The investigations were commissioned as a result of widespread consumer concern about charges levied by the Water Authority. The Commission will explain its terms of accounting to the water authority and publish its findings in advertisements in local newspapers for public comment. Many public pressure and consumer groups have already responded in writing to invitations for response from the Commission, and matters deemed worthy of further study are examined in public interest hearings. The Commission members are appointed by the Secretary of State and represent a wide range of job disciplines. Public interest hearings are attended only by water company representatives and Commission members, and all discussions are protected by the Official Secrets Act. Following hearings, reports are written up within 3 to 6 months containing the Commission's recommendations and conclusions. These reports become part of a larger full report which will be published by the Department of Trade. (Geiger-FRC)
W81-00909

EVALUATING THE TOXICITY OF EFFLUENTS,
Los Angeles Bureau of Sanitation, CA.
W. F. Garber.
Progress in Water Technology, Vol 12, No 3, p 57-67, 1980. 2 Fig, 2 Tab, 31 Ref.

Descriptors: *Regulation, *Toxins, *Effluents, *Standards, *Adoption of practices, Administrative decisions, Oceans, California, Toxicity, Methodology, Water pollution control, Water policy.

Major emphasis in the U.S. has been placed on setting standards and regulating toxins before scientific knowledge is established as to the toxicity of safe levels of these toxins. Limitation of the amount of toxic materials released into the environment is a major goal of a waste water treatment system. The only way to decide if known toxins should be manufactured and used, controlled by any type of treatment, or regulated by what partiticular standards, is to advance scientific knowledge of these substances. The State of California Ocean Plan, which governs the diffusion of treated wastewaters to the ocean, is described. The policies which guided its development, the methodology used to determine desired receiving water concentrations, and the resulting standards are presented and discussed. The scarcity of reliable bioassay information is emphasized. The present California standards are believed adequate to protect the environment. The federal insistence on near zero risk is believed unnecessary. (Small-FRC)
W81-00915

IMPLEMENTING PRETREATMENT REQUIREMENTS IN THE UNITED STATES: A STUDY OF FOUR PUBLIC AGENCIES TREATING DOMESTIC AND INDUSTRIAL WASTEWATER,
Lynam (Bart T.) and Associates, Chicago, IL.
B. T. Lynam, R. M. Linton, and K. Kirk.
Progress in Water Technology, Vol 12, No 3, p 13-21, 1980.

Descriptors: *Regulation, *Waste water treatment, *Municipal wastes, *Industrial wastes, *Toxins, Legislation, Governments, Sludge disposal, Cities, Pretreatment, Federal Water Pollution Control Act of 1972, Chattanooga, Tennessee, Rockford, Illinois, Oakland, California, New Bedford, Massachusetts.

The Association of Metropolitan Sewerage Agencies studied how four municipalities were confronting the U. S. Environmental Protection Agency's requirement that industrial users of municipal treatment systems meet pretreatment standards. The four systems: Chattanooga, Tennessee; Rockford, Illinois; Oakland, California; and New Bedford, Massachusetts, faced different problems because of differences in size, treatment process, industrial waste loadings, and geographic location. The experiences of water pollution professionals in these cities indicate that the federal requirements are achievable but start-up and operating costs are high. Industry will in general be hard-pressed to pay the costs of reasonable pretreatment. Deciding how much to charge each industry using the treatment facility is also a problem. Little is known about the 65 toxic pollutants which are regulated, and disposal of the highly toxic sludges in a cost-effective and environmentally sound fashion will be difficult. (Small-FRC)
W81-00916

THE RELATIONSHIP BETWEEN WATER CONSERVATION AND MINERAL DEVELOPMENT,
Alabama Univ. University. School of Law.
H. Cohen.
Alabama Law Review, Vol 31, No 3, p 547-609, Summer, 1980.

Descriptors: *Mineral industry, *Oil industry, *Water conservation, Mine wastes, *Legal aspects, *Industrial production, Evaluation, Planning, Mining, Coal mine wastes, Water pollution, Mine drainage, Water law, Legislation, Institutional constraints, Water policy, Governments, Oil wells, Natural gas, Waste disposal wells, Alabama, Pennsylvania.

This report briefly surveyed the background of the national energy problem and the common law applicable to the relationship between mineral production and water pollution, and discussed the water-related problems that might arise from an accelerated mineral production program. State law relative to mining and water pollution was discussed for Pennsylvania and Alabama, as well as in relation to the Federal Water Pollution Control Act (FWPCA). Although the underpinnings of the legal controls affecting both water conservation and mineral production were deemed sound, improvements in the present system were suggested. These suggestions included: (1) mapping and definition of all abandoned underground/surface mines and oil/gas wells to delineate specific effects on water resources; (2) Congressional ammendment of FWPCA and Surface Mining Control and Reclamation Act to define jurisdictional limits of EPA and the Office of Surface Mining Reclamation and Enforcement relative to mining pollution control activities; (3) new State legislation for municipalities supplying drinking water, to investigate/inspect activities that may endanger water supply; (4) State legislature definitions of pollution that includes those withdrawing large amounts of water that reduces water quality, as polluters; and (5) Congressional exemption of certain oil/gas disposal wells from Safe Drinking Water Act coverage not impacting freshwater aquifers. (Zielinski-IPA)
W81-00967

A HISTORY OF DRAINAGE LAW IN MINNESOTA WITH SPECIAL EMPHASIS ON THE LEGAL STATUS OF WET LANDS,
Mankato State Univ., MN. Dept. of Biological Sciences.
K. E. King.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134900, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota, Minneapolis, Bulletin 106, November, 1980. 48 p, 28 Ref, 5 Append. OWRT-A-040-MINN(6).

Descriptors: *Drainage practices, *Wetlands, *Legal aspects, *Minnesota, *Drainage effects, Drainage, Drainage patterns, Drainage programs, Evaluation, Planning, Drainage water, Water law, Water permits, Water rights, Bodies of water, Public rights, Water distribution(Applied), Jurisdiction, Institutional constraints.

A capsulized view was presented of the laws and attitudes that have shaped the drainage history of Minnesota and have formed the basis for Minnesota's present drainage law. The presentation was divided into three temporal periods: 1858-1920 (drainage period I (DP-I)), 1920-1960 (DP-II), and 1960-1979 (DP-III). DP-I in Minnesota's history was a time of extensive drainage activity. Of the total land acreage incorporated into drainage enterprises by 1960, over 79% was affected by ditching before 1920. Acts that facilitated drainage and the legal status of State water bodies were discussed for this period. DP-II represented a time of transition in State attitudes towards drainage and water; while DP-III very likely witnessed the most dramatic statutory changes in State drainage history for water resources protection and management. Special importance was placed on the evolution of the law as pertaining to wetlands. A set of appendices provided a more detailed view of certain laws and significant legal precedents. It was concluded that, if present economic patterns persist, and landowners become dissatisfied with present laws governing public waters, more drainage is likely; and, with each wetland drained, conflicts over those remaining will escalate. (Zielinski-IPA)
W81-00969

LEGAL, FINANCIAL AND ECONOMIC ANALYSIS OF A WATER SUPPLY BANK IN IDAHO,
Idaho Univ., Moscow. Center for Business Development and Research.
C. Hofmann, J. Wegman, and F. Damanpour.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-149486. Price codes: A07 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, University of Idaho, Technical Completion Report, August, 1980. 147 p, 3 Fig, 1 Tab, 76 Ref. OWRT-B-047-IDA(1), 14-34-0001-9112.

Descriptors: *Water allocation policy, *Legal aspects, *Economic feasibility, *Idaho, *Financial feasibility, Water supply, Pricing, Irrigation, Water districts, Water users, Water delivery, Planning, Evaluation.

Water banking can conceptually facilitate the development of rational market mechanisms for water. Idaho has authorized the establishment of a Water Supply Bank to be operated by the Idaho Water Resources Board. This study analyzes the legal, financial and economic feasibility of the Water Supply Bank. Water banking will supplement existing water transfers by water management and delivery organizations in providing access to market allocation mechanisms. While water banking can improve and facilitate the operation of market forces in water pricing and allocation, constraints on rational markets still exist. These constraints are prohibition on water transfers where adverse third-party effects are evident and institutional encumbrance which require a fixed price for the rental of storage water.
W81-00977

FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT GOALS, OBJECTIVES AND PRIORITIES FOR SOUTH CAROLINA, 1982-1987,
Clemson Univ., SC. Water Resources Research Inst.
P. B. Zielinski, and J. Vorgettes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134918, Price codes: A06 in paper copy, A01 in microfiche. Report No 91 submitted to the Office of Water Research and Technology, August, 1980. 100 p, 4 Fig, 17 Tab, 25 Ref, 1 Append.

Descriptors: *Research priorities, *South Carolina, *Planning, *Research and development, *Water quality, Water management(Applied), Water resources, Water pollution, Institutions, Optimum development plans, Desilting, Oxidation lagoons, Waste disposal, Wastes, Evaluation, Water reuse, Waste water(Pollution), Water utilization, Groundwater, Alternative planning, Project planning, Programs, Investigation, *Five-year plans.

The five-year water resources research plan for South Carolina presented background meteorological, hydrological, and geological information, a description of past/current studies, and identified water problems. Principal South Carolina water

problems were placed in three broad priority categories: those of water quality as top priority; followed by those of water resources planning and management; followed by those of water quantity. Water quality problems identified included ground/surface water pollution source identification, coastal zone groundwater pollution, waste discharges in surface waters, improved treatment performance needs for waste stabilization ponds, reduction of siltation and high nutrient levels in order to reverse lake eutrophication, and monitoring and safe disposal of toxic waste. Planning/management problems included the need for adequate groundwater data to support passage of controlling legislation; while water quantity problems included reuse and recycling of waste water effluents, and severe groundwater withdrawals in parts of the coastal plains. An estimated funding profile based on the identified priorities and covering fiscal years 1982-1986 was included. (Zielinski-IPA)
W81-00986

6G. Ecologic Impact Of Water Development

RIPARIAN HABITAT AND INSTREAM FLOW STUDIES, LOWER VERDE RIVER: FORT MCDOWELL RESERVATION, ARIZONA,
Fish and Wildlife Service, Albuquerque, NM.
For primary bibliographic entry see Field 2E.
W81-00756

EFFECT OF NUTRIENT MANIPULATION ON PLANKTON COMMUNITY STRUCTURE,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. Lang, and E. J. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134892, Price codes: A02 in paper copy, A01 in microfiche. Completion Report 79-10, October, 1980, 10 p, 17 Ref. OWRT-A-066-ALAS(1), 14-34-001-9002.

Descriptors: Phosphorus, Carbon, *Aquatic micoorganisms, *Plankton, Species composition, Alaska, *Lakes, *Ecosystems, Nutrient requirements, *Laboratory tests, *Cultures, Evaluation, Environmental effects, Macronutrient ratios.

The primary objective of this study was to use laboratory continuous cultures to evaluate the effect of changing macronutrient ratios on the microplankton species compositions of lake ecosystems. The heterotrophic yeast could outcompete the green alga for phosphate, so the alga only predominates when carbon severly limited the growth of the yeast. Most evidence indicates that heterotrophes are better competitors for mineral nutrients (like phosphorus) than are algae. Thus, in oligotrophic systems, the total biomass of the microplankton community may be limited by a mineral nutrient, but the community structure may be regulated by the type of organisms available to the heterotrophic population. The dominance of unicellular blue-greens in oligotrophic systems (since they are better competitors for phosphorus than the yeast or green alga) may be due to their ability to take up dilute phosphorus. As nutrient concentrations increase towards eutrophy, other factors such as zooplankton grazing and allelopathy may be most important in determining the structure and biomass of the microplankton community.
W81-00973

VARIATION IN INVERTEBRATE DRIFT IN SUBARCTIC ALASKAN STREAMS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
J. D. LaPerriere.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134884, Price codes: A03 in paper copy, A01 in microfiche. Completion Report 77-22-A, August, 1980. 27 p, 1 Fig, 9 Tab, 45 Ref. OWRT-A-061-ALAS(1), 14-34-001-9002.

Descriptors: *Aquatic drift, *Benthos, *Alaska, *Invertebrates, Streams, Arctic, Subarctic, *Ecosystems, Ecological distribution, Environmental effects, Algae, Phosphorus, Alkalinity, Streamflow, Velocity, Sediment-water interfaces, Forecasting, Equations.

Data from thirteen streams in interior, subarctic Alaska are analyzed to find predictive equations that explain the amount of invertebrate fish-food drifting in the water column. The alkalinity of the water and the stream's average velocity are found to be the factors that influence the amount of drift expressed as concentration or export rate. The alkalinity is shown to be related to the invertebrates' food supply. Average velocity is speculated to be an indication of the shear force at the sediment-water interface where benthic invertebrates forage for their food. These shear forces are seen to operate on benthic invertebrates in an analogous way to that in which they operate in sediment transport. The algae of boreal streams in this region are shown to be somewhat reliant on alkalinity, but a highly significant relationship is shown between total phosphorus and algae when both muskeg (brownwater) and boreal (clearwater) streams are considered together. Brownwater streams of this region tend to have a higher total phosphorus concentration than clearwater streams, but not to have a depressed pH that is characteristic of standing waters in muskeg. Recommendations are presented for further research.
W81-00974

EFFECTS OF MARSH IMPOUNDMENTS ON COASTAL FISH AND WILDLIFE RESOURCES,
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
R. H. Chabreck.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 1-16. 19 Ref.

Descriptors: *Marsh management, *Wildlife management, *Impoundments, *Coastal marshes, *Environment effects, Wetlands, Marshes, Habitat improvement, Marsh plants, Hydrology, Wildlife, Freshwater marshes, Brackish water, Water resources, Fish, Vegetation, Salinity, Water birds.

Marsh impoundments are widely used in coastal regions for improving wildlife habitat, aquaculture, water storage for agricultural irrigation and industrial uses, flooding marshes for mosquito control, and maintaining favorable water depths for navigation. Impoundments can be categorized on a basis of water level and salinity regimes into four types: permanently flooded with fresh water, manipulated fresh water, permanently flooded with brackish water, and manipulated brackish water. The vegetational and hydrological characteristics of each type of impoundment are discussed, and the effects of those characteristics on providing the habitat required for waterfowl, coots, gallinules, rails, wading birds, fur animals, alligators, freshwater fishes, estuarine fishes, and crawfish are described for coastal areas of the south Atlantic and Gulf coastal wetlands are primary factors regulating their value to fish and wildlife resources. Wildlife have preferences for different species of vegetation; consequently the plant species composition of an area often governs the animal species in the area. Hydrological factors such as salinity and tidal action may affect species tolerance or regulate access to the area. (Moore-SRC)
W81-00991

CONTRIBUTION OF WOODED SWAMPS AND BOTTOMLAND FORESTS TO ESTUARINE PRODUCTIVITY,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
J. W. Day, Jr., W. H. Conner, and G. P. Kemp.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 33-50. 6 Fig, 3 Tab, 26 Ref.

Descriptors: *Estuaries, *Swamps, *Forests, *Productivity, *Hydrology, *Ecology, Environmental gradient, Wetlands, Forest management, Flow, Nutrients, Wildlife, Land management, Water management(Applied), Bottom sediments, Canal construction, Channels, Vegetation.

The value of cypress swamps and bottomland forests for wildlife habitats and water regulation is well-recognized, but studies of the ecology and management of estuaries have rarely taken the role of these freshwater systems into consideration. Swamp forests of the southeastern United States are highly productive, and this high productivity is related to water flow. Chemical dynamics of swamps are very complex and strongly affected by local physical, hydrological and geological conditions. Higher water flow generally leads to more aerobic conditions, but this is affected by sediment type. The development of an oxygenated water column and sediment surface promotes the uptake of most inorganic forms. Swamps and bottomlands also have a marked effect on hydrological patterns. The vegetation, soils and topography of swamps result in the internal stabilization of often erratic water regimes. Swamps can affect estuarine productivity by serving as nursery habitat, by contributing nutrients, and by stabilizing hydrological conditions. Hydrology is a key consideration in both the management of swamps and swamp-estuary couplings. This includes land management as it affects water movement. Important areas for management include channelization, canal construction, spoil placement and water quality. (Moore-SRC)
W81-00993

RECENT ADVANCES IN OUR UNDERSTANDING OF SALT MARSH ECOLOGY,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
A. A. de la Cruz.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 51-65. 1 Fig, 55 Ref. NA79AA-D-000-49.

Descriptors: *Coastal marshes, *Salt marshes, *Ecology, *Detritus, Wildlife, Fish, Aquatic plants, Methodology, Productivity, Food chains, Cycling nutrients, Aquatic habitats, Decomposing organic matter, Estuarine environment, Marsh management, Conservation.

The functions of the salt marsh as a producer and reservoir of energy and nutrients, and as a vital habitat for fish and wildlife have been the subject of recent studies. The main issue in marsh grass productivity studies has been methodology: the traditional Harvest Method is still the most used procedure, but not without modifications. Variability in sampling procedures and differences in the methods and formulae have prevented reliable comparisons of marsh productivity data. The energy flow in the salt marsh follows a Y-shaped pathway, the grazing food chain and the detritus food chain. The relationship between the marsh and the secondary productivity of adjacent estuarine waters depends on: the production of abundant detritus from marsh plant material; the flux of the formed plant detritus into the water that inundates the marsh; and the assimilation of detritus particles and dissolved detritus by products into the food web that supports secondary production. Caloric and nutrient analysis data from decomposing detritus of estuarine marsh species indicate that energy and protein values remain high and in most cases increase, during decomposition to particulate detritus. Marshes appear to be both sinks and sources of organic material. Most of the recent conservation and management studies are related to the habitat functions of marshes for wildlife and as sites for fish and shellfish aquacultural development.
W81-00994

STUDIES OF FRESHWATER NEEDS OF FISH AND WILDLIFE RESOURCES IN NUECES-CORPUS CHRISTI BAYS, TEXAS,
Fish and Wildlife Service, Austin, TX.
For primary bibliographic entry see Field 2L.
W81-00996

ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT: AN OVERVIEW,
National Coastal Ecosystems, Team, Slidell, LA.
C. L. Cordes.
In: Proceedings of the Gulf of Mexico Coastal Ecosystems Workshop, September 4-7, 1979, Port Aransas, Texas, Fore, P. L., and Peterson, R. D., Eds., Fish and Wildlife Service, Office of Environment, Report FWS/OBS-80/30, May, 1980, p 185-189. 5 Ref.

Descriptors: *Planning, *Management, *Environmental effects, *Ecosystems, *Social aspects, *Economic impact, Alternative planning, Wildlife, Habitats, Resources development.

Resource managers and others concerned with protecting fish and wildlife, and their habitats are primarily involved in the environmental assessment process in a reactive review role. Planned developments are primarily designed within an economic context and rarely include a thorough consideration of environmental uncertainties. What often results are confrontations among representatives of various interest groups, most of whom had no opportunity to participate in the original project design. However, the methodologies of adaptive environmental assessment and management insure that environmental dimensions are integrated as equal elements with economic and social considerations at the very beginning of the development or management design process. Alternative management policies and development plans are generated in an atmosphere of open communication between developers and resource managers, and each alternative is collectively assessed for its environmental, economic, and social consequences. Flexibility is encouraged in project designs and management strategies so they may be adapted to unexpected ecological events and adjusted to benefit from information feedback throughout the development process. (Moore-SRC)
W81-00999

7. RESOURCES DATA

7B. Data Acquisition

TRACKING MOVEMENT AND IDENTIFICATION OF IN-STREAM FLOW NEEDS OF BROWN TROUT (SALMO TRUTTA) BY USE OF RADIO-ISOTOPES,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
L. S. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-140568, Price codes: A04 in paper copy, A01 in microfiche. M.S. Thesis, December, 1980. 66 p, 9 Fig, 7 Tab, 51 Ref, 1 Append. OWRT B-038-WYO(2), 14-34-0001-8130.

Descriptors: *Fish behavior, *Brown trout, *Tracking techniques, Telemetry, Ice cover, *Ice-water interfaces, Wyoming, Streams, *Instream flow.

Medium-sized brown trout were tracked under surface ice in a small Wyoming foothills stream. A portable single-channel analyzer and NaI (Tl) crystal and photomultiplier tube were used to locate fish implanted with 0.5 milliCuries of Antimony-124. At each fish location water depth, ice depth, mean velocity, velocity at the water surface, and substrate velocity were measured. Substrate type and cover type were also recorded. Frequency of use of various depth, velocity, and substrate classes was determined. Predictive equations were also developed relating percent habitat excluded to various parameters.
W81-00753

THE ANALYSIS AND FATE OF ODOROUS SULFUR COMPOUNDS IN WASTEWATERS,
Los Angeles County Sanitation Districts, Whittier, San Jose Creek Water Quality Lab. CA.
R. L. Jenkins, J. P. Gute, S. W. Krasner, and R. B. Baird.
Water Research, Vol 14, No 5, p 441-448, May, 1980. 8 Fig, 2 Tab, 18 Ref.

Descriptors: *Sulfur compounds, *Waste water treatment, *Odor, *Instrumentation, *Pollutant identification, Analytical techniques, Calibrations, Gas chromatography, Flame photometry, Sampling, Industrial wastes, Water pollution sources, Treatment facilities.

An analytical system for odorous organosulfur compounds based on gas chromatography together with the sulfur specific flame photometric detector and capable of registering data in the ppb (ml odorant/ml air) range is presented. For storage and handling of standard compounds in the calibration system, a high vacuum line was found preferable to permeation tubes as being more representative of procedures used in field analysis, even though the vacuum apparatus is more complex. The use of gas syringes was another integral feature of the calibration system. A vacuum bulb apparatus for collecting ambient air at field sites is described. The waste-water sampling device allows the odor potential of a liquid sample to enter a relatively large evacuated chamber, thus releasing volatile sulfur compounds into the headspace. Gaseous mixtures have been found less susceptible to loss when kept in aqueous solutions. The analytical system was tested by tracing and characterizing an odor incident from a treatment plant to the industrial discharge source. In cases of major odor problems, the odorant can be determined both at the treatment facility and at the point of discharge. In low or moderate odor incidents, the major odorant may derive from long-chain mercaptan decomposition in aeration treatment facilities. Mercaptan loss and alteration may also make it impossible to trace the major odorant to its source of discharge chromatographically. (Just-FRC)
W81-00776

FLOW-THROUGH IN SITU METABOLIMETER FOR MONITORING OXYGEN CONSUMPTION, PRODUCTION AND DIFFUSION IN NATURAL WATERS,
Fisheries Research Inst., Szarvas (Hungary).
J. Olah, A Zsigri, and P. Szabo.
Water Research, Vol 14, No 5, p 553-556, May, 1980. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Measurement, *Oxygen requirements, *Bodies of water, On-site tests, Mathematical models, Instrumentation, Eutrophication, Respiration, Diffusion, Analytical techniques.

A flow-through in situ metabolimeter was developed to measure and monitor oxygen production, consumption and diffusion directly in highly eutrophic natural waters. The instrument works by the direct measurement of the daily rhythm of both respiration and diffusion, whereby it is possible to avoid or minimize the sources of error that occur with the analytical method based on the mathematical calculation of daily oxygen curves which has been proposed by Winberg and Odum for estimating oxygen turnover. Use of the instrument allows the investigator to work without empirical and theoretical constants and hypotheses which may vary according to water type and environmental and meteorological conditons. (Baker-FRC)
W81-00779

OBTAINING PRECISE ESTIMATES IN COLIFORM ENUMERATION,
College of Staten Island, NY. Dept. of Biology.
J. M. Fleisher, and R. T. McFadden.
Water Research, Vol 14, No 5, p 477-483, May, 1980. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Bioindicators, *Water quality, *Coliforms, Water pollution, Analytical techniques, Membranes, Filtration, Fermentation, Statistical methods, Water analysis.

The use of proper experimental design and improved techniques of coliform enumeration were combined to achieve a significant improvement in the quantitative use of coliforms as water-quality indicators. Samples of water were taken from a mildly polluted beach area on Staten Island. The membrane filtration technique was used to analyze the water samples. Density estimates were analyzed by a nested analysis of variance. Up to 95% of the variation in coliform density could be ascribed to actual temporal changes in density when replicated determinations were made. Replicated determinations allowed the construction of confidence intervals about the estimates which were considerably smaller than with single determinations when the variances of the density estimates were decreased. The theoretical superiority of the membrane filtration method of water quality analysis over the multiple tube fermentation method is discussed. (Baker-FRC)
W81-00782

UNCERTAINTY IN DISSOLVED OXYGEN PREDICTION DUE TO VARIABILITY IN ALGAL PHOTOSYNTHESIS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
G. M. Hornberger.
Water Research, Vol 14, No 4, p 355-361, April, 1980. 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Mathematical models, *Photosynthetic oxygen, *Dissolved oxygen, *Algae, *Monte Carlo method, Oxygen sag, Primary productivity, Time series analysis, Statistical methods, Rivers, Water quality.

Monte Carlo methods were used to evaluate the contribution of variance in river community metabolism to overall uncertainty in predictions from dissolved oxygen (DO) models. The modification of the Streeter-Phelps equation used in this work includes the effect of community metabolism on the DO balance. The results of the Monte Carlo simulations show that not only is community metabolism an important element in water quality models, but because rates of photosynthesis and respiration cannot be taken as constant, uncertainty in parameters used to model community metabolism must be considered when probability distributions of DO in rivers are estimated. This conclusion was shown to be valid for a wide range of conditions and therefore applies to all but the most heavily polluted or highly turbid waters. The observed mean daily oxygen concentrations and corresponding standard deviations for the Mechums River, the South River and the Rappahannock River are 8.36 (0.42) mg/liter, 8.35 (0.35) mg/liter, and 8.85 (0.71) mg/liter, respectively. The fact that these observed standard deviations are closely approximated by the Monte Carlo results suggests that this simulation technique may be quite useful in practice provided an estimate for the mean and variance of P-R (productivity and reaeration) can be established. Use of a refined version of the oxygen balance equation that takes into account the diel variation in algal productivity shows that variance in dissolved oxygen in rivers is likely to be much larger than that predicted by models that use mean daily values of net production. (McKeon-FRC)
W81-00787

LABORATORY MANAGEMENT IN METHODS DEVELOPMENT,
PJB Labs./Jacobs Engineering, Pasadena, CA.
J. H. Taylor, C. Jackson, M. Miller, and D. R. Rushneck.
Journal of Environmental Science and Health, A, Vol 15, No 5, p 393-411, 1980. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Analytical techniques, *Gas chromatography, *Pollutant identification, Management, *Laboratories, Research and development, Chemical wastes, Testing procedures, Chemical industry, Laboratory tests.

Management practices employed in operations at an analytical laboratory are surveyed. The laboratory is responsible for the Organic Chemicals Verification Project, which is intended to provide analytical methodology, analytical data, and engineering information to characterize product/process wastewaters from EPA designated organic chemicals manufacturing plants. Using samples obtained at the plants, the laboratory is to analyze the in-process and waste streams for the Consent Decree Priority Pollutants. The organizational structure that is necessary to the operation is de-

tailed, and information is provided on the tools used to maintain operational control, such as status sheets, work order forms, and flow diagrams. The development of specific methods to meet the needs of specific projects is described. Three major managerial precepts used to accomplish the program include the use of a well-defined set of program objectives and priorities, assuming that technical solutions do exist and then locating and employing these technical solutions, and the development of methods that result in the simplest, most cost-effective analysis. Information is given on scheduling, logistics and cost accounting. To date, methods have been developed for a total of 78 streams from nine organic chemicals manufacturing plants. All but three of these streams were able to be monitored using only GC, not GC/MS methods. (Baker-FRC)
W81-00800

ZOOPLANKTON GRAZING AS A CONTROL MECHANISM IN ALGAL BLOOMS. A METHOD FOR THE STUDY OF THE EFFECT OF ALGAL TOXINS ON ZOOPLANKTON VERTICAL MIGRATION,
New Hampshire Univ., Durham. Dept. of Zoology.
J. F. Haney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-143364, Price codes: A03 in paper copy, A01 in microfiche. Water Resource Research Center, University of New Hampshire, Research Report 31, 1980. 24 p, 12 Fig, 9 Ref. OWRT-A-053-NH(1), 14-34-0001-9031.

Descriptors: *Zooplankton, *Algal toxins, *Vertical migration, *Chaoborus, *Daphnia, Aquatic life, Algal blooms, Toxins, Blue-green algae, Cyanophyta, Laboratory tests, Analytical techniques, Monitoring, *Diel migration, Echo sounder, Algal extract, Sonar recorder.

A method was developed to study the effect of blue-green alga toxins on the diel vertical migration of zooplankton. The usefulness of a high-frequency echo sounder to follow the diel movements of zooplankton was first tested in the field. Zooplankton were then placed in model lake systems (2.5 m high columns) in the laboratory. The echo sounder was modified to reduce the wave length of the sound output, thereby increasing the vertical resolution characteristics. Other modifications were also made to adapt the unit for use in these shallow systems. Maximum resolution was obtained by interfacing the sonar recorder with anoscilloscope so that the vertical position of individual zooplankton (Chaoborus and Daphnia) could be determined plus or minus 2.5 cm in a 200 cm column of water. Studies were conducted to calibrate the position and width of sonar traces against visual counts of the vertical distribution of animals in the columns. A monitoring system was designed to automatically track the movements of populations of zooplankton at 15 to 30 minute intervals over 24-hour periods. Size and shape of the columns should be matched to the sound characteristics of the sonar to avoid interference from multiple echos and artifacts caused by echos form the sides of the column. Preliminary studies of the effects of soluble toxins extracted from a bloom of blue-green algae indicate sublethal doses may alter the timing and extent of the vertical migration.
W81-00804

***THE APPLICATION AND CONDUCT OF RING* TESTS IN AQUATIC TOXICOLOGY,**
Unilever Research Colworth/Welwyn Lab., Bedford (England).
M. J. How.
Water Research, Vol 14, No 4, p 293-296, April, 1980. 1 Tab, 8 Ref.

Descriptors: *Reviews, *Aquatic environment, *Testing procedures, *Toxicity, Lethal limits, Water pollution, Laboratory tests, Aquatic animals, Standards, Data collections, Networks, Analytical techniques.

In this letter to the editor, some aspects of the ring test (collaborative test) as applied to aquatic toxicology are reviewed. Ring tests generally employ several laboratories to determine the toxicity of a specific chemical to a certain organism under predetermined conditions. Standard methods are essential during ring tests, and each laboratory should be supplied with detailed testing procedures. It is recommended that the agreed-upon method be tested by one laboratory for sensitivity and practicality. Full ring tests are costly exercises. Compounds to be tested should be stable, representative of actual aquatic pollutants, and free of other contaminants. Strict adherence to time schedules is important for participating laboratories. Experimental design starts with mini-ring tests, followed by the actual ring test, then the reporting of LC50 values with 95% confidence limits. The organizational flow chart for ring tests is presented. It is stressed that these tests should only be conducted when necessary. (Geiger-FRC)
W81-00870

THE CAVTAT ACCIDENT: EVALUATION OF ALKYL LEAD POLLUTION BY SIMULATION AND ANALYTICAL STUDIES,
Istituto di Recercha sulle Acque Bari (Italy).
G. Tiravanti, A. Rozzi, M. Dall Aglio, W. Delaney, and A. Dadone.
Progress in Water Technology, Vol 12, No 1, p 49-65, 1980. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Lead, *Analytical techniques, *Model studies, Sediments, Sea water, Water pollution sources, Ships, Tetraethyl lead, Tetramethyl lead, Adriatic Sea.

Potential marine and coastal pollution by alkyl lead was evaluated by mathematical models, and specific field and laboratory procedures were developed for lead analysis in sea water. These strategies were developed following the sinking of the Yugoslavian cargo ship Cavtat to a depth of 93 m in the Adriatic Sea. The Cavtat carried 325 tons of tetraethyl and teramethyl lead. A mathematical model capable of simulating the diffusive and convective transport of released lead is presented, including the numerical solution. Analytical and numerical solutions of the diffusion model agree well for locations farther than 200 m downstream from the source. Specific field and laboratory procedures were developed for lead analysis in sea water. Sea water samples collected 100 m to several kilometers from the wreck gave lead values lower than 0.1 microgram/liter. The average lead concentrations in sediments were 15 ppm, which is normal for marine sediments. Lead levels were also normal in biota sampled before, during, and after recovery operations. (Small-FRC)
W81-00895

DETERMINATION OF NITRITE ION IN WASTE AND TREATED WATERS BY RESONANCE RAMAN SPECTROMETRY,
Meidensha Electric, Tokyo (Japan). Water Treatment Engineering Div.
For primary bibliographic entry see Field 5A.
W81-00927

DETECTION OF SALINE SEEPS.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-134843, Price codes: A06 in paper copy, A01 in microfiche. Completion Report for Office of Water Research and Technology from Water Resources Institutes in South Dakota, North Dakota and Montana, June, 1980. 101 p, 38 Fig, 20 Tab, 26 Ref. OWRT-B-043-SDAK(1), 14-34-0001-6117.

Descriptors: *Remote sensing, *Aerial photography, *Soil-water-plant relationships, *Saline water, *Seepage, Detection, Thermal radiation, Photogrammetry, Reflectivity, Seismic, Investigations, Electrical prospecting, Saline seeps, Growth rates, Montana, North Dakota, South Dakota.

The purpose of this study was to develop and test remote sensing techniques for detection of potential sites for seep development, for detection of seeps in an early stage of development and for monitoring the rate of growth of active seeps. Due to the regional nature of the problem, test sites were selected in Montana, North Dakota, and South Dakota. Aerial photography and thermal data were supported by ground truth on each site. The data collected did not relate well to digitized data from remote sensing products. Apparently the saline seep-soil-crop complex included variability not accounted for by the data collected. However, trained photointerpreters can delineate saline seeps using photo data products with reasonable degree of accuracy (70 to 80%) if they understand seep mechanisms, soils, and geology as well as photo interpretation methods. Incipient and latent seeps were difficult to identify regardless of the data products used for interpretation. Thermal imagery may be useful in locating wet zones that are potential seeps.
W81-00975

7C. Evaluation, Processing and Publication

SURFICIAL GEOLOGY OF RICHLAND QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Geological Survey Open-File Report 80-763 (WRI), 1980. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, *New York, Hydrogeology, Water wells, Water yield, Maps, *Oswego County,(NY).

The location and extent of 12 kinds of surficial deposits in Richland quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology potential for ground-water development at any specific location. (USGS)
W81-00813

SURFICIAL GEOLOGY OF PART OF CLEVELAND QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Syracuse Univ., NY.
E. H. Muller, and T. S. Miller.
Geological Survey Open-File Report 80-762 (WRI), 1980. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, *New York, Hydrogeology, Water wells, Water yield, Maps, *Oswego County(NY).

The location and extent of six kinds of surficial deposits in part of Cleveland quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and potential for ground-water development at any specific location. (USGS)
W81-00814

SURFACE-WATER AVAILABILITY, GREENE COUNTY, ALABAMA,
Geological Survey, University, AL. Water Resources Div.
A. L. Knight, and M. E. Davis.
Alabama Geological Survey Map 149, 1980. 5 p, 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Surface water availability, *Streamflow, *Water quality, *Alabama, Runoff, Rainfall-runoff relationships, Flow rates, Water yield, Chemical analysis, Maps, Hydrologic data, Greene County(AL).

The average annual runoff originating in Greene County, Ala., is about 16 inches or 0.8 Mgal/d (million gallons per day) per square mile. The Black Warrior and Tombigbee Rivers, at their confluence, have a combined average flow of 14,100 Mgal/d; each has a median annual 7-day low flow in excess of 300 Mgal/d. The Sipsey River, along the northern boundary of the county, has an average flow in excess of 600 Mgal/d and a median annual 7-day low flow of 45 Mgal/d.

Streams within the county have average flows less than 60 Mgal/d and median annual 7-day low flows less than 2 Mgal/d. Surface water generally contains less than 120 mg/L (milligrams per liter) dissolved solids, less than 20 mg/L chloride, and generally is soft to moderately hard. (USGS)
W81-00815

GEOLOGY AND WATER AVAILABILITY OF CULLMAN COUNTY, ALABAMA,
Geological Survey, Louisville, KY. Water Resources Div.
R. J. Faust, and P. O. Jefferson.
Alabama Geological Survey Map 145, 1980. 30 p, 4 Fig, 3 Plates, 3 Tab, 13 Ref.

Descriptors: *Geology, *Groundwater, *Available water, *Surface waters, *Alabama, Aquifer characteristics, Water wells, Well data, Water yield, Hydrogeology, Streamflow, Flow rates, Water storage, Water quality, Chemical analysis, Water utilization, Maps, Hydrologic data, Cullman County(AL).

The Pottsville Formation of Pennsylvanian age underlies most of Cullman County in northern Alabama. It consists mostly of interbedded sandstones and shales that dip southward about 40 feet per mile. The Bangor Limestone of Mississippian age underlies the Pottsville and crops out in a few valleys along the northern boundary of the county. The principal source of ground water in the county is the Pottsville Formation. Sandstones of the Pottsville Formation underlying low topographic areas will yield as much as 200 gal/min (gallons per minute) to individual wells 200 feet deep or less in the southeastern part of the county and 25-100 gal/min in other parts of the county. Those underlying high topographic areas generally yield less than 3 gal/min. The average flow of streams in and adjoining Cullman County is about 1,500 Mgal/d (million gallons per day) which includes about 780 Mgal/d that originates in the county. Discharge from ground-water storage is small, and most streams cease to flow during extended dry periods. Sipsey Fork and Mulberry Fork are the only streams in and adjoining Cullman County that have median annual 7-day low flows that exceed 2 Mgal/d. Chemical analyses of water in the county indicate the water is suitable for most uses, but iron concentrations in ground water exceed 0.3 mg/L (milligrams per liter) in many places. Water use in Cullman County was estimated to average 5.6 Mgal/d in 1967. (USGS)
W81-00816

AVAILABILITY OF SURFACE WATER IN LOWNDES COUNTY, ALABAMA,
Geological Survey, University, AL. Water Resources Div.
J. R. Willmon.
Alabama Geological Survey Map 153, 1980. 7 p, 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Available water, *Surface waters, *Streamflow, *Water quality, *Alabama, Flow rates, Rainfall-runoff relationships, Chemical analysis, Maps, Hydrologic data, Lowndes County(AL).

The flow of streams in Lowndes County, Ala., is highest during January through April and lowest during September and October. The Alabama River, which forms the northern boundary of the county, has an average flow of 16,800 Mgal/d (million gallons per day) at the northwest corner and a 7-day Q sub 2 (median annual 7-day low flow) of more than 1,000 Mgal/d. Big Swamp Creek near Lowndesboro has an average flow of 200 and a 7-day Q sub 2 of 0.1 Mgal/d. The 7-day Q sub 2 of each of the remaining streams within the county is less than 2 Mgal/d. Lowndes County receives about 1,770 Mgal/d (52 inches) of water from rain, of which 1,190 Mgal/d returns to the atmosphere through evapotranspiration, and the remaining 580 Mgal/d appears as runoff in streams. Water from streams in the county is moderately hard to hard, has a moderately low mineral content, and is suitable for most uses. (USGS)
W81-00817

SURFACE-WATER AVAILABILITY, TUSCALOOSA COUNTY, ALABAMA,
Geological Survey, University, AL. Water Resources Div.; and Geological Survey, Austin, TX. Water Resources Div.
A. L. Knight, and M. E. Davis.
Alabama Geological Survey Map 139, 1980. 12 p, 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Surface water availability, *Streamflow, *Water quality, *Alabama, Flow rates, Water yield, Low flow, Water storage, Chemical analysis, Maps, Hydrologic data, Tuscaloosa County(AL).

The average annual runoff, about 1,270 Mgal/d (million gallons per day), originating in Tuscaloosa County, Ala., is equivalent to 20 inches or 0.95 Mgal/d per square mile. The Black Warrior and Sipsey Rivers, the largest streams in the county, have average flows of 5,230 Mgal/d and 580 Mgal/d, respectively, where they leave the county, and median annual 7-day low flows in excess of 150 Mgal/d and 35 Mgal/d, respectively. North River, Big Sandy Creek, and Hurricane Creek have average flows in excess of 100 Mgal/d and median annual 7-day low flows in excess of 2 Mgal/d. Surface water generally contains less than 100 mg/L (milligrams per liter) dissolved solids, less than 10 mg/L chloride, and is soft to moderately hard. Streams having the higher hardness and the higher dissolved-solids content are in eastern Tuscaloosa County. (USGS)
W81-00818

SURFACE-WATER AVAILABILITY, ST. CLAIR COUNTY, ALABAMA,
Geological Survey, University, AL. Water Resources Div.
J. R. Harkins.
Alabama Geological Survey Map 148, 1980. 10 p, 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Surface water availability, *Streamflow, *Water quality, *Alabama, Rainfall-runoff relationships, Flow rates, Low flow, Water yield, Water storage, Water temperature, Chemical analysis, Maps, Hydrologic data, St. Clair County(AL).

The Coosa River, the largest source of water in St. Clair County, Ala., has an average flow of 602 Mgal/d (million gallons per day) where it enters the county and 8,500 Mgal/d where it leaves the county. H. Neely Henry and Logan Martin Reservoirs, which extend along the eastern boundary of the county, have average storage capacities of 132,500 and 359,600 acre feet, respectively. Big Canoe Creek, which flows through the northern part of the county, is the largest stream in the county other than the Coosa River. It has an average flow of 210 Mgal/d at its confluence with H. Neely Henry Reservoir. Water in streams in St. Clair County is of good chemical quality and is suitable for most uses. Water in Big Canoe Creek is generally soft to moderately hard. Water in the Coosa River is generally soft. (USGS)
W81-00819

WATER AVAILABILITY OF BLOUNT COUNTY, ALABAMA,
Geological Survey, Louisville, KY. Water Resources Div.
R. J. Faust, and J. R. Harkins.
Alabama Geological Survey Map 141, 1980. 19 p, 4 Fig, 2 Plates, 4 Tab, 15 Ref.

Descriptors: *Available water, *Groundwater, *Surface waters, *Water quality, *Alabama, Aquifer characteristics, Water wells, Well data, Water yield, Hydrogeology, Streamflow, Flow rates, Rainfall-runoff relationships, Chemical analysis, Water utilization, Maps, Hydrologic data, Blount County(AL).

Ground water in Blount County, Ala., is obtained mostly from limestone and dolomite aquifers along the Sequatchie anticline and Murphrees Valley anticline and from sandstone aquifers in Sand Mountain and Blount Mountain synclinal areas. Wells tapping some limestone and dolomite aquifers produce as much as 1.4 Mgal/d (million gallons per day). Wells completed in sandstone of the Pottsville Formation underlying lower topographic areas may produce as much as 0.3 Mgal/d, but those completed in sandstone underlying higher topographic areas produce lesser quantities. Surface-water resources were appraised by use of average flow and 7-day Q2 (median annual 7-day minimum flow). An average flow of about 640 Mgal/d or about 1 Mgal/d per square mile originates in the county. Streamflow during low flow conditions is small; only three streams have 7-day Q2's that exceed 2 Mgal/d. Estimates of storage requirements are provided for sustained draft rates of 25 to 50% of the average flow. Water from aquifers and streams in Blount County is generally of suitable chemical quality for most uses. Water from the Pottsville Formation generally contains iron in excess of 0.3 milligram per liter and water from limestone and dolomite aquifers and from some streams during low flows is moderately hard to hard and may need treatment for certain uses. Water use in the county was about 3.2 Mgal/d in 1968 and 46 Mgal/d was diverted for use outside the county. (USGS)
W81-00820

WATER AVAILABILITY, SHELBY COUNTY, ALABAMA,
Geological Survey of Alabama, University.
V. M. Shamburger, and J. R. Harkins,.
Alabama Geological Survey Map 140, 1980. 32 p, 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Available water, *Groundwater, *Surface waters, *Water quality, *Alabama, Aquifer characteristics, Water wells, Well data, Water yield, Hydrogeology, Streamflow, Flow rates, Rainfall-runoff relationships, Chemical analysis, Water utilization, Maps, Hydrologic data, Shelby County(AL).

The largest sources of ground water in Shelby County, Ala., are limestone and dolomite aquifers which are potential sources of about 0.5 Mgal/d (million gallons per day) per well. The most favorable well sites are in valleys or low topographic areas and adjacent to faults. Yields of wells rarely increase at depths greater than 350 feet except in fractured zones along faults. The major sources of surface water are the Coosa and Cahaba Rivers. The Coosa River is impounded by Lay Dam, which forms a lake of 145,000 acre-feet of water at elevation 396 feet above mean sea level. The Coosa and Cahaba Rivers have average flows of 9,400 Mgal/d and 400 Mgal/d, respectively at their lower reaches in the county. The Coosa River will provide more than 1,000 Mgal/d; whereas, the Cahaba River, Shoal Creek, and Buck Creek along their lower reaches in the county are each capable of providing water at the rate of 10 Mgal/d or more without storage. The county has an average annual precipitation of 54 inches of which about 20 inches runs off in streams. The 20 inches of runoff is equivalent to 800 Mgal/d or 1.0 Mgal/d per square mile. Ground water is of suitable chemical quality for most uses, but water from some sources may be objectionable for certain uses because of hardness or iron content. Surface water is of suitable chemical quality for most uses. Water use in the county in 1969 was estimated to be 5.6 Mgal/d, which is insignificant when compared to the total available supply. (USGS)
W81-00821

WATER AVAILABILITY IN CHILTON COUNTY, ALABAMA,
Geological Survey of Alabama, University. Water Resources Div.
J. S. Ellard, and J. R. Willmon.
Alabama Geological survey Map 146, 1980. 16 p, 3 Fig, 2 Plates, 3 Tab, 12 Ref.

Descriptors: *Available water, *Groundwater, *Surface waters, *Water quality, *Alabama, Aquifer characteristics, Water wells, Well data, Water yield, Hydrogeology, Streamflow, Flow rates, Chemical analysis, Water utilization, Maps, Hydrologic data, Chilton County(AL).

The largest sources of water in Chilton County, Ala., are sand, limestone, and dolomite aquifers,

and the Coosa River and Mulberry Creek. The principal sand aquifer in the southwestern part of the county will yield 0.5 to 1.0 Mgal/d (million gallons per day) per well. Limestone and dolomite aquifers in the northwestern part generally will yield less than 0.5 Mgal/d per well but locally will yield 0.5 Mgal/d or more. Metamorphic-rock aquifers in northern and eastern parts of the county generally yield less than 0.1 Mgal/d to individual wells. Wells developed in the principal sand aquifer range in depth form less than 100 feet along the northern margin of the aquifer to about 800 feet in the southwest corner of the county. Wells developed in limestone, dolomite, and undifferentiated metamorphic-rock aquifers are rarely drilled deeper than 300 feet. The Coosa River has an average flow of 10,100 Mgal/d and a 7-day Q sub 2 that exceeds 1,000 Mgal/d in the southeast corner of the county. Mulberry Creek, where it flows out of the county, has an average flow of about 180 Mgal/d and an estimated 7-day Q sub 2 of 34 Mgal/d. Water from aquifers and streams in Chilton County is generally of suitable chemical quality for most uses. Water from sand aquifers and metamorphic-rock aquifers is generally soft to moderately hard and locally contains iron in excess of 0.3 mg/L (milligram per litre). Water from limestone and dolomite aquifers is generally moderately hard to hard and has an iron content that is less than 0.3 mg/L. Water from streams has a low dissolved-solids content and is soft. The estimated use of water in Chilton County in 1969 was about 3 Mgal/d which is less than 1% of the quantity available. (USGS)
W81-00822

MAP SHOWING GROUND-WATER CONDITIONS IN THE CANYON DIABLO AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA--1979,
Geological Survey, Tucson, AZ. Water Resources Div.
C. L. Appel, and D. J. Bills.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, 50 cents in microfiche. Geological Survey Open-File Report 80-747 (WRI), May, 1980. 1 Sheet, 9 Ref.

Descriptors: *Maps, *Groundwater, *Aquifer characteristics, *Water wells, *Water quality, Water levels, Specific conductivity, Fluorides, Arizona, Coconino County(AZ), Navajo County(AZ), Canyon Diablo area(AZ).

The Canyon Diablo area includes about 1,400 square miles in northeastern Arizona. The main source of ground water is the Coconino aquifer, which includes the Kaibab Limestone, the Cononino Sandstone, and the upper member of the Supai Formation. In places the alluvium and volcanic rocks yield water to wells and springs. Information on the map includes altitude of the water level, depth to water, and specific conductance and fluoride concentration in the water. Scale 1:125,000. (USGS)
W81-00823

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, ARCTIC SLOPE ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-554, 1980. 18 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *Artic Slope(AK).

This report, which is one of a series of reports for Alaska, lists stations in Arctic Slope, Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of Arctic Slope, Alaska, and a table listing the types of data collected and periods of record. (USGS)
W81-00824

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, SOUTH-CENTRAL ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-600, 1980. 54 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *South-central Alaska.

This report, which is one of a series of reports for Alaska, lists stations in south-central Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of south-central Alaska and a table listing the types of data collected and periods of record. (USGS)
W81-00825

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, YUKON BASIN, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $5.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-552, 1980. 41 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *Yukon Basin(AK).

This report, which is one of a series of reports for Alaska, lists stations in Yukon Basin, Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of Yukon Basin, Alaska, and a table listing the types of data collected and periods of record. (USGS)
W81-00826

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, SOUTHWEST ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-551, 1980. 13 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *Southwest Alaska.

This report, which is one of a series of reports for Alaska, lists stations in southwest Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of southwest Alaska, and a table listing the types of data collected and periods of record. (USGS)
W81-00827

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, NORTHWEST ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-533, 1980. 19 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *Northwest Alaska.

This report, which is one of a series of reports for Alaska, lists stations in northwest Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of northwest Alaska and a table listing the types of data collected and periods of record. (USGS)
W81-00828

INDEX OF STREAMFLOW AND WATER-QUALITY RECORDS TO SEPTEMBER 30, 1978, SOUTHEAST ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-698, 1980. 26 p, 1 Fig, 1 Tab.

Descriptors: *Alaska, *Streamflow, *Water quality, *Data collections, Streams, Gaging stations, Sites, Drainage area, *Southeast Alaska.

This report, which is one of a series of reports for Alaska, lists stations in southeast Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of southeast Alaska and a table listing the types of data collected and periods of record. (USGS)
W81-00829

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1979--VOLUME 1. MISSOURI RIVER BASIN,
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103129, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WY-79-1, July, 1980. 642 p, 9 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Missouri River basin(WY).

Water resources data for the 1979 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Volume 1 of this report contains discharge records for 166 gaging stations; stage only records for 1 lake; stage and contents for 11 lakes and reservoirs; water quality for 116 gaging stations, 101 ungaged stations, 70 wells and springs; and water levels for 36 observation wells. Also included are 75 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. This data represents that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (USGS)
W81-00833

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1979--VOLUME 1. GREAT BASIN AND SNAKE RIVER BASIN ABOVE KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-120909, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ID-79-1, September, 1980. 385 p, 12 fig.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Great Basin(ID), *Snake River basin(ID).

Water resources data for the 1979 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 183 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 23 lakes and reservoirs; water-quality for 91 gaging stations, 42 partial-record stations, and 173 wells; and water levels for 388 observation wells. Also included are data for 57 crest-stage partial-record stations and 191 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W81-00834

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1979--VOLUME 2. UPPER COLUMBIA RIVER BASIN AND SNAKE RIVER BASIN BELOW KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-120917, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ID-79-2, September, 1980. 345 p.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Upper Columbia River basin(ID), *Snake River basin(ID).

Water resources data for the 1979 water for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 183 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 23 lakes and reservoirs; water-quality for 91 gaging stations, 42 partial-record stations, and 173 wells; and water levels for 388 observation wells. Also included are data for 57 crest-stage partial-record stations and 191 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W81-00835

SURFICIAL GEOLOGY OF TEXAS QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Syracuse University, NY.
E. H. Muller, and T. S. Miller.
Geological Survey Open-File Report 80-760 (WRI), 1980. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, *New York, Hydrogeology, Water wells, Water yield, Maps, Oswego County(NY).

The location and extent of nine kinds of surficial deposits in Texas quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and potential for groundwater development at any specific location. (USGS)
W81-00837

8. ENGINEERING WORKS

8A. Structures

THE DESIGN AND CONSTRUCTION OF THE P K LE ROUX DAM,
Department of Water Affairs, Pretoria (South Africa). Engineering Dept.
A. G. Davies.
The Civil Engineer in South Africa (Johannesburg), Vol 20, No 10, p 249-259, October, 1978. 15 Fig, 12 Ref.

Descriptors: *Dam design, *Construction, *Engineering geology, Concrete-dams, Dams, Dam foundation, Flood control, Overflow, Seepage, Sediment control, Rock mechanics, Design flood, Topography, Structural behavior, Hydroelectric power, River flow, Erosion, Scour, Statistics, South Africa.

The logistics, engineering, and geological factors involved in the design and construction of the P K le Roux Dam, Orange River Project, South Africa, is described. It is South Africa's highest and second largest dam, 108 m high with a crest length of 770 m and a full supply capacity of 3,255 million cubic meters of water. The location is about 124 km downstream of the Hendrik Verwoerd Dam. The dam was constructed on a dolerite sill in a deep narrow gorge. The meridians of the arch are logarithmic spirals symmetrical about an axis down river and the radius of curvature increases from crown to flanks. The dam is exposed to flash floods and it has a free overspill with a crest length of 212 m. The overspill apron extends downstream to prevent scour of the foundation. Silt outlet and a gated spillway are provided for efficient operation and maintenance. The instrumentation, concreting, cooling system, and hydroelectric power station of the dam are described in detail. The construction phases of the dam are outlined and the methods used for river diversion are explained. All engineering statistics and construction dates are listed. (Sidney-IPA)
W81-00794

8B. Hydraulics

THE IMPACT OF PUMPED STORAGE OPERATION ON THE VERTICAL TEMPERATURE STRUCTURE IN A DEEP LAKE: A MATHEMATICAL MODEL,
Eidgenoessische Anstalt fuer Wasservorsorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
D. M. Imboden.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P. Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 125-146. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Pumped storage, *Mathematical models, *Limnology, *Thermal stratification, *Hydroelectric plants, Climates, Reservoirs, Thermoclines, Water temperature, Heat balance, Mixing.

A mathematical model of vertical temperature structure is presented for a typical pumped storage power plant system where water is cycled between a natural lake (lower reservoir) and an artificial (upper) reservoir. Thermocline models, wind mixing, vertical diffusion, meterorological forces, pumped storage operation, thermal energy balance, and heat exchange in the upper reservoir are considered in developing the pumped storage model. In order to demonstrate the synergetic effects of the perturbations introduced into a lake by a pumped storage power plant, the natural temperature and mixing regime of Lake Lucerne is exposed to a hypothetical pumped storage power plant. The main effect of pumped storage lies in a delay of the onset of the stagnation period from mid March to mid May. At the surface the warming of the water is delayed by a little more than one month. The seeming paradox of lower surface temperature and larger heat content is resolved by the permanent existence of a thermocline between 8 and 12 m depth. The pumped storage plant causes an increase in the vertical heat transport into the lake accompanied by a slight temperature increase below 8 m. (Moore-SRC)
W81-00849

COMBINED USE OF PHYSICAL AND MATHEMATICAL MODELS IN EVALUATING THE EFFECTS OF PUMPED STORAGE OPERATION ON THE THERMAL STRUCTURE OF A RESERVOIR,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
D. N. Brocard, E. E. Adams, and S. Bloss.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 147-157.

Descriptors: *Pumped storage, *Hydroelectric plants, *Model studies, *Thermal stratification, *Limnology, Mathematical models, Reservoirs, Water temperature, Mixing, Thermoclines.

The possible effects of a proposed pumped storage project on the thermal structure of its lower reservoir were investigated by use of the combination of a physical model and a mathematical model. Pumped storage operations were simulated in a prestratified scale model of the proposed lower reservoir and measured temperatures were used to calibrate the mixing and selective models used in the mathematical simulation. The latter was then used to predict the thermal regime of the reservoir with pumped storage. The major effect of pumped storage is to mix the upper layers of the reservoir resulting in a deepening of the epilimnion. During the spring and early summer near surface temperatures are increased by 1 to 2 degrees C while at middle depths temperatures are increased substantially. Below the level of the tailrace there is little change. During the late summer the surface begins to cool, convective mixing takes place, and the thickness of the epilimnion increases rapidly. The increased heat content now results in surface temperatures which are higher during pumped storage operation than under natural conditions. There is also a larger temperature difference below the tailrace. (Moore-SRC)
W81-00850

EFFECTS OF VERTICAL SCALE DISTORTION ON THE PERFORMANCE OF THERMAL-HYDRAULIC MODELS OF PUMPED STORAGE SYSTEMS,
West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics.
R. A. Bajura, and S. H. Schwartz.
In: Proceedings of the Clemson Workshop on Environmental Impacts of Pumped Storage Hydroelectric Operations, May 15-16, 1979, Clemson, South Carolina, Clugston, J.P., Ed., Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-80/28, April, 1980, p 158-176. 9 Fig, 8 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, *Model studies, *Thermal stratification, Reservoirs, Water temperature, Limnology, Hydraulics.

Since most reservoirs are exceedingly broad compared to their depth, the scaled depth in a thermal-hydraulic model may be unacceptably small. One solution to this modeling dilemma is the use of a distorted model in which the vertical depth is exaggerated. A model of a hypothetical pumped storage facility was constructed at a scale ratio of 1:240 for the undistorted case. Two other models were constructed with distortion ratios of 3 and 5. Tests were conducted for a range of Froude numbers from 2 to 10 for both the generation and pumpback modes of operation for the three tailrace models. The amount of warm water injected was varied between 7% and 25% of the initial volume of the model reservoir. It is concluded that the effect of vertical scale distortion on the perform-

ance of a thermal-hydraulic model of a pumped storage reservoir outlet is significant. Distorted models are characterized by a greater degree of mixing and lower surface temperatures as compared to the undistorted model. (Moore-SRC)
W81-00851

8D. Soil Mechanics

DEVELOPMENT OF PHREATIC SURFACES IN EARTH EMBANKMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. S. Desai, and T. Kuppusamy.
Report VPI-E-80.22 to Water and Power Resources Service, May, 1980. 54 p, 34 Fig, 12 Ref.

Descriptors: *Free surfaces, *Model studies, *Embankments, *Earth dams, *Seepage, Earthworks, Water levels, Reservoirs, Hydraulic models, Soil stability, Soil water, Computer models.

Transient or time dependent movements in water levels caused by rise and drawdown in the reservoir can influence significantly the stability and integrity of dams or embankments that retain the reservoir. The fluctuations in water level cause transient seepage in the dam and such flow is accompanied by the existence of the free or phreatic surface. The computer code called SEEP-2DFE has been modified, and used to study free surface locations due to a rise in reservoir level. In order to verify the predictions from finite element computations, a laboratory model was designed and constructed, using glass beads to simulate soil media. Comparisons between predictions and observations were satisfactory. A parametric study was performed by using the code to investigate the possibility of the overshooting phenomenon in a zoned dam. It indicated that in the upstream shell and core regions, the phreatic surface rose monotomically and did not show overshooting. A small amount of overshooting was seen in the downstream shell area. (Moore-SRC)
W81-00758

8I. Fisheries Engineering

TRACKING MOVEMENT AND IDENTIFICATION OF IN-STREAM FLOW NEEDS OF BROWN TROUT (SALMO TRUTTA) BY USE OF RADIO-ISOTOPES,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W81-00753

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